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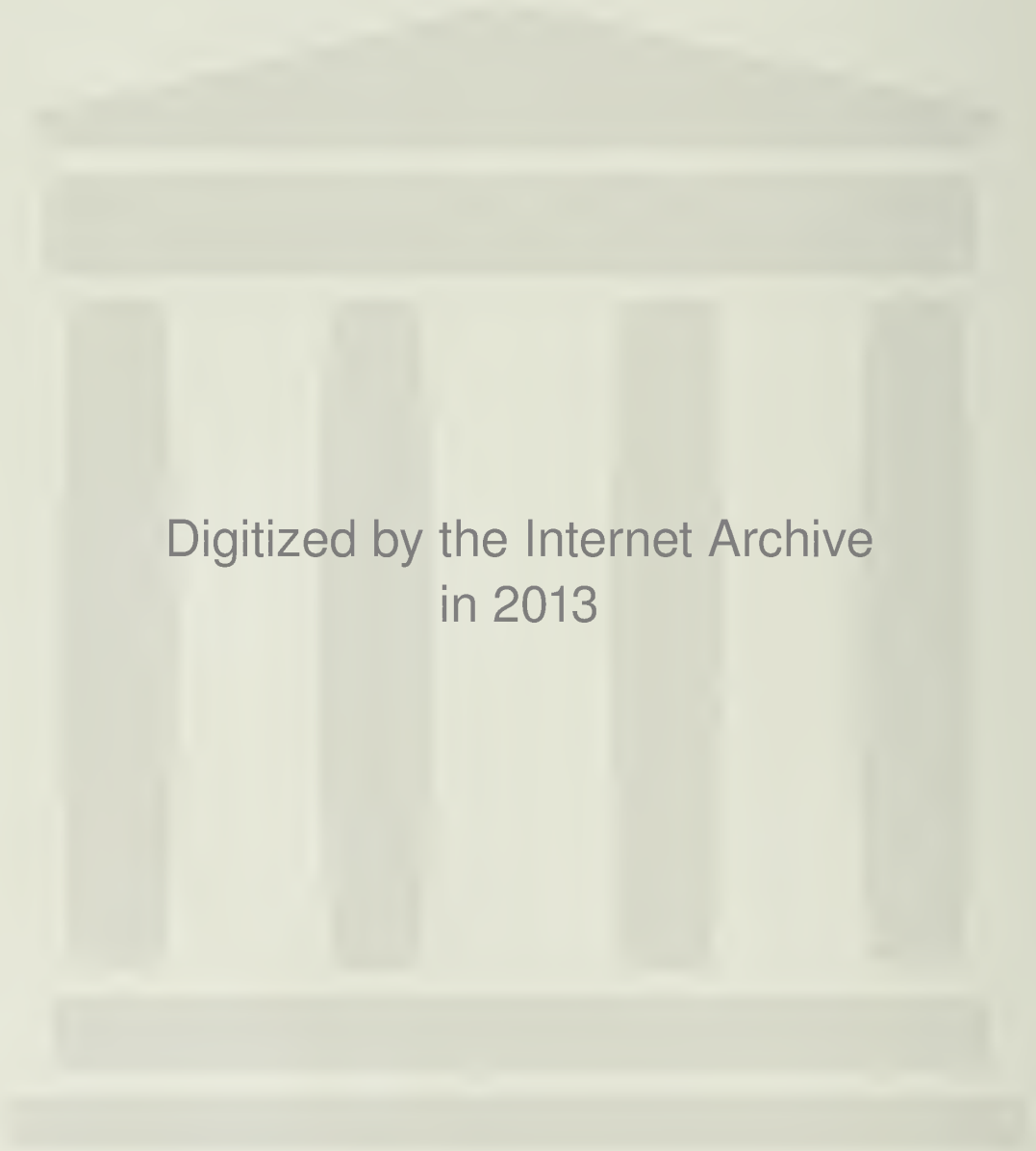
1963-1965 GRADUATE COLLEGE CATALOG

NURSING
MEDICINE
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UNIVERSITY OF ILLINOIS AT THE MEDICAL CENTER, CHICAGO

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1963-1965

UNIVERSITY
OF ILLINOIS
AT THE
MEDICAL CENTER
CHICAGO

GRADUATE COLLEGE CATALOG

DENTISTRY
MEDICINE
PHARMACY
NURSING

PUBLISHED BY
THE UNIVERSITY
OF ILLINOIS
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CALENDAR 1963-1964

1963 — SUMMER QUARTER

Registration.....June 11, Tuesday
Instruction begins.....June 17, Monday
Independence Day (classes dismissed).....July 4, Thursday
Labor Day (classes dismissed).....September 2, Monday
Quarter ends.....September 7, Saturday

1963 — FALL QUARTER

Registration.....September 24, Tuesday
Instruction begins.....September 30, Monday
Thanksgiving Day (classes dismissed).....November 28 and 29
Quarter ends.....December 21, Saturday

1964 — WINTER QUARTER

Registration.....December 17, Tuesday
Instruction begins.....January 6, Monday
Quarter ends.....March 21, Saturday

1964 — SPRING QUARTER

Registration.....March 17, Tuesday
Instruction begins.....March 30, Monday
Latest date for filing completed thesis.....May 22, Friday
Memorial Day (classes dismissed).....May 30, Saturday
Latest date for filing results of oral examination.....June 5, Friday
Commencement.....June 12, Friday
Quarter ends.....June 13, Saturday

1964 — SUMMER QUARTER

Registration.....June 16, Tuesday
Instruction begins.....June 22, Monday
Independence Day (classes dismissed).....July 4, Saturday
Labor Day (classes dismissed).....September 7, Monday
Quarter ends.....September 12, Saturday

ACTIVE TEACHING FACULTY FOR GRADUATE WORK AT THE MEDICAL CENTER

- ABOOD, LEO GEORGE, Ph.D., Associate Professor of Biological Chemistry and of Neurophysiology
- ABRAMSON, DAVID IRVIN, M.D., Professor of Physical Medicine and Rehabilitation, Head of the Department, and Professor of Medicine
- ALPERT, NORMAN ROLAND, Ph.D., Associate Professor of Physiology
- ANDERSON, AXEL G., D.D.S., Professor of Oral and Maxillofacial Surgery and Head of the Department
- BAILEY, ORVILLE T., A.B., M.D., Professor of Neurology
- BARNOTHY, MADELEINE F., Ph.D., Associate Professor of Physics
- BATSON, HERBERT CLIFFORD, Ph.D., Professor of Biostatistics
- BAUER, LUDWIG, Ph.D., Associate Professor of Chemistry
- BEATTIE, EDWARD JAMES, JR., A.B., M.D., Professor of Surgery
- BELL, CHARLES L., Ph.D., Assistant Professor of Chemistry
- BENNETT, GRANVILLE ALLISON, B.S., M.D., Professor of Pathology and Dean of the College of Medicine
- BINKLEY, STEPHEN BENNETT, Ph.D., Professor of Biological Chemistry
- BLAKE, MARTIN, Ph.D., Professor of Pharmacy and Head of the Department
- BLISS, HARRY AMESMAN, A.B., M.D., Assistant Professor of Medicine
- BLISS, RACHEL, A.M., Associate Professor of Nursing
- BLOMQUIST, CONRAD ALVIN, Ph.D., Associate Professor of Pharmacognosy
- BRODIE, ALLAN GIBSON, D.D.S., Ph.D., Professor of Orthodontics and Head of the Department
- BURKMAN, ALLAN M., Ph.D., Assistant Professor of Pharmacology
- CAMP, WALTER JOHN RICHARD, M.D., Ph.D., Professor of Pharmacology
- CARDEW, EMILY C., M.S., Professor of Nursing
- CARLIN, HERBERT S., M.S., Assistant Professor of Pharmacy
- CATCHPOLE, HUBERT RALPH, Ph.D., Research Professor of Pathology
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- COVIELLO, DOMINICK A., Ph.D., Assistant Professor of Chemistry
- CRANE, FRANK A., Ph.D., Assistant Professor of Pharmacognosy
- DANIELS, RALPH, Ph.D., Associate Professor of Chemistry
- DEARDORFF, DWIGHT LUVERNE, Ph.D., Professor of Manufacturing Pharmacy
- DEFEO, VINCENT J., Ph.D., Assistant Professor of Anatomy
- DEINHARDT, FRIEDRICH W., M.D., Associate Professor of Microbiology
- DOWLING, HARRY FILMORE, A.B., M.D., Professor of Medicine and Head of the Department
- DUBRUL, E. LLOYD, D.D.S., Ph.D., Professor of Oral Anatomy
- DUNN, HELEN S., M.S.N.E., Assistant Professor of Nursing
- ECANOW, BERNARD, Ph.D., Assistant Professor of Pharmacy
- ENGEL, MILTON BAER, D.D.S., Professor of Orthodontics
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- GOMOLL, ALLEN W., Ph.D., Assistant Professor of Pharmacology

GRAND, NICHOLAS B., D.D.S., M.S., Associate Professor of Oral Pathology
 GREENBERG, RUVEN, Ph.D., Associate Professor of Physiology
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 JOSEPH, NORMAN ROSS, Ph.D., Associate Professor of Chemistry
 JULIAN, ORMAND C., M.D., Ph.D., Professor of Surgery
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 KHOUBYARIAN, NEWTON, Ph.D., Assistant Professor of Microbiology
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 KRAKOWER, CECIL ALEXANDER, B.S., M.D., C.M., Professor of Pathology and Head
 of the Department
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 KROEGER, ARTHUR VOELKEL, Ph.D., Assistant Professor of Microbiology
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 OMACHI, AKIRA, Ph.D., Associate Professor of Physiology
 OSTFELD, ADRIAN, M.D., Associate Professor of Preventive Medicine
 OVADIA, JACQUES, Ph.D., Assistant Professor of Radiology
 PERKINS, ALFRED JAMES, Ph.D., Associate Professor of Chemistry
 PIRANI, CONRAD LEVI, M.D., Professor of Pathology
 PLAGGE, JAMES CLARENCE, Ph.D., Professor of Anatomy
 PRUZANSKY, SAMUEL, D.D.S., M.S., Associate Professor of Orthodontics
 PUMPER, ROBERT W., Ph.D., Associate Professor of Microbiology
 RAFELSON, MAX EMANUEL, JR., Ph.D., Professor of Biological Chemistry
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 of the Department
 ROSTENBERG, ADOLPH, JR., A.B., M.D., C.M., Professor of Dermatology and Head
 of the Department
 SABET, TAWFIK Y., Ph.D., Research Associate in Orthopaedic Surgery
 SABSHIN, MELVIN, M.D., Professor of Psychiatry and Head of the Department
 SADOVE, MAX SAMUEL, M.D., Professor of Surgery
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 SCHOUR, ISAAC, D.D.S., Ph.D., D.Sc., Professor of Histology, Head of the Depart-
 ment, and Dean of the College of Dentistry
 SCHULMAN, MARTIN P., Ph.D., Associate Professor of Pharmacology
 SCHWARTZ, NEENA BETTY, Ph.D., Associate Professor of Physiology
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 SHERROD, THEODORE ROOSEVELT, Ph.D., M.D., Professor of Pharmacology
 SIBAL, LOUIS R., Ph.D., Assistant Professor of Microbiology
 SIEGEL, FREDERICK, Ph.D., Assistant Professor of Pharmacy
 SIMER, PARKE HARVEY, Ph.D., Professor of Anatomy
 SKY-PECK, HOWARD, Ph.D., Assistant Professor of Biological Chemistry
 SMITH, CEDRIC MARTIN, M.D., M.S., Associate Professor of Pharmacology
 STERN, KURT, M.D., Professor of Pathology
 SWERDLOW, MARTIN A., B.S., M.D., Associate Professor of Pathology

TAYLOR, J. LANGDON, JR., Ph.D., Assistant Professor of Physiology
TEDESCHI, HENRY, Ph.D., Assistant Professor of Physiology
TITCHENER, EDWARD B., Ph.D., Assistant Professor of Biological Chemistry
UNNA, KLAUS ROBERT, M.D., Professor of Pharmacology and Head of the Department
VAN ALTEN, PIERSON J., Ph.D., Assistant Professor of Anatomy
VICHER, EDWARD ERNEST, Ph.D., Associate Professor of Microbiology
VOIGT, RALPH FERDINAND, Ph.D., Professor of Pharmacognosy and Head of the Department of Pharmacology and Pharmacognosy
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THE GRADUATE COLLEGE

The University of Illinois offers graduate instruction at its Medical Center in Chicago leading to the degrees of Master of Science and Doctor of Philosophy in the basic sciences of anatomy, biological or pharmaceutical chemistry, microbiology, pathology, pharmacognosy, pharmacology, physiology, and certain applied science areas. The work is intended primarily for the training of men and women for teaching and research careers in the general health science area. Students who obtain graduate degrees in these areas are ideally oriented for positions on the basic science teaching staffs of dental, medical, pharmacy, and nursing schools.

The faculty members who teach graduate courses and act as advisers to graduate students are also members of the faculties of the Colleges of Dentistry, Medicine, Pharmacy, and Nursing and thus tend to emphasize the relationship between the basic medical sciences and their clinical applications.

Postgraduate refresher courses or other reviews of a strictly professional character are not included in the Graduate College and no credit toward a Master of Science or Doctor of Philosophy degree is allowed for any type of professional course, review, or routine. Those interested in technical or advanced professional training can find opportunities for this kind of work in the postgraduate curricula offered in certain departments of the professional colleges.

LOCATION, HISTORY, AND ORGANIZATION

The Graduate College at the Medical Center is located on the west side of Chicago. The campus, which is about three miles west of the downtown business area, is reached conveniently by elevated train or bus. The work of the College is centralized in the Dentistry-Medicine-Pharmacy buildings facing on Polk, Wood, and Wolcott Streets.

The University of Illinois offered facilities for advanced study and research in some fields as early as 1872. Organized graduate instruction under the name of the Graduate School, however, began in 1892. In 1894 the administration of the School was vested in the Council of Administration with the Vice-President of the University as Dean of the School. In 1906 the Graduate School was organized as a separate faculty and in 1947 it became known as the Graduate College.

Members of the faculty at the Medical Center in Chicago were first appointed to the graduate faculty in 1924. An Associate Dean of the Graduate College is responsible for graduate work conducted at the professional colleges. The teaching faculty includes members of the University faculty approved to give instruction in graduate courses.

College policies pertaining to graduate work in the medical sciences are

initiated by the Executive Committee at the professional colleges division of the Graduate College. Recommendations of this committee concerning faculty appointments and curricula are submitted to the Dean of the Graduate College at Urbana for approval.

Inquiries concerning graduate study in the basic health related sciences should be directed to the Associate Dean, Graduate College, University of Illinois, 1853 West Polk Street, Chicago 12, Illinois.

Students interested in graduate study in areas other than those specified above should address their inquiries to the Dean of the Graduate College, University of Illinois, Urbana, Illinois.

OBJECTIVES AND STANDARDS

Graduate education is predominantly an intellectual adventure and has as its chief objective the encouragement of advanced intellectual achievement in the form of productive scholarship and research.

Graduate training is not a matter of successfully completing a number of advanced courses but emphasizes chiefly original laboratory or basic investigation. A major requirement for both the Master of Science and Doctor of Philosophy degrees is a thesis based in a research problem. Students must devote at least one-half of their time to the thesis. Degrees are granted to students (1) whose level of scholarship and investigative endeavor proves that they have mastered a definite field of knowledge and recognize its potentialities and opportunities for further advances, (2) who are able to integrate this knowledge with related domains of fact and understanding, and (3) who have proved themselves as independent and original scholarly investigators. The program, which is primarily one of training for research and teaching in the medical sciences, is entirely distinct from postgraduate training in the medical specialities.

High standards of admission are maintained, and careful selection and individual approval of faculty members is made to supply qualified advisers to graduate students. Laboratory, clinical, and library facilities are superior. Rigid tests in courses and examinations showing evidence of ability for productive research are requirements for normal progress toward a graduate degree.

ADMISSION

Admission to the Graduate College may be granted to graduates of institutions whose requirements for the professional or bachelor's degree are substantially equivalent to those of the University of Illinois, provided the undergraduate major is in biological science or chemistry or the undergraduate training includes organic chemistry, biology, and physics. A Bachelor of Science degree in pharmacy or nursing is required in some disciplines, and the M.D. or D.D.S. degree may be a prerequisite for some areas of

graduate study. All applicants should have credit for at least one year of French or German. Superior students pursuing a medical or dental curriculum may be accepted on a highly selective basis.

Applicants should demonstrate a desire for graduate training in the basic health related sciences and should expect to make teaching and research in one of these branches a lifetime endeavor.

Each applicant must submit with his application for admission an official transcript of his college record and letters of recommendation from those who are acquainted with his previous academic record. In order to qualify for admission, an applicant must have a scholastic average of at least 3.5¹ or its equivalent in his undergraduate work. For medical or dental graduates the average is based on both the preprofessional and professional record. After evaluation of all credentials, final acceptance is recommended by the head of the department, and the student is notified by the Graduate College. Registration is dependent on passing a mental and physical examination conducted by the University Health Service. Admission may be on probationary status. A student originally admitted on probation may be admitted to full status upon completion of the equivalent of a full quarter of satisfactory work (three units of A or B) in formal courses.

Before final admission is granted to applicants whose scholastic average is less than 3.75, they must take the Graduate Record Examination consisting of the aptitude test and the advanced test in either biology or chemistry. These tests are administered at numerous centers throughout the country several times each year. To secure application forms and information concerning the time and place of the next examination, write to the Educational Testing Service, Princeton, New Jersey. Students who are currently pursuing the dental or medical curriculum or those who already have attained the Doctor of Dental Surgery or Doctor of Medicine degree are not required to take these tests. Provisional acceptance pending completion of the examination may be arranged with the Associate Dean for those applicants who have excellent undergraduate records.

Applicants must complete the following procedure before applications can receive final consideration:

1. Forward completed application forms to the department of choice.
2. Direct all institutions where academic work has been pursued to forward an official transcript to the department of choice.
3. Request two instructors most closely associated with the applicant's present field of interest to write letters of recommendation to the department of choice.

¹ Average halfway between B and C. Transcripts from institutions using a different grading scale are evaluated by the Associate Dean of Admissions and Records in terms of the University of Illinois system. Averages are computed on the following basis: A = 5; B = 4; C = 3; D = 2; E (failure) = 1.

4. Make arrangements to take the Graduate Record Examination and have the results forwarded to the department of choice (those with less than 3.75 undergraduate average).

It is also desirable to arrange for a personal interview, and in certain instances it may be required.

Each applicant who is tentatively accepted should arrange with the University Health Service on this campus for a physical examination as promptly as possible. It is strongly urged that each applicant visit his own dentist and physician before registration, especially for (1) any needed dental work, (2) refraction and fitting for glasses if needed, (3) vaccination against smallpox, (4) typhoid immunization, (5) tetanus immunization, (6) diphtheria immunization or a booster, and (7) a chest X-ray. A Mantoux test for tuberculosis is also advisable. After registration the student will find it difficult to have these essential things done without loss of time from study.

The University Health Service offers emergency medical care to all students. All students participate in the University of Illinois hospital and medical service insurance program.

RESEARCH FACILITIES

The University buildings contain the administrative offices of the College, the library, lecture rooms, classrooms and large laboratories for classwork, numerous small laboratories for individual research, an autopsy amphitheater, and the clinics and hospitals. The last include the University of Illinois Research and Educational Hospitals and the Neuropsychiatric Institute. The Illinois Eye and Ear Infirmary is located near the campus. This infirmary is operated jointly by the University and the Illinois Department of Mental Health. Close to the college campus are the Cook County Hospital, Chicago-State Tuberculosis Hospital, West Side Veterans Administration Hospital, and Presbyterian-St. Luke's Hospital, all of which are used for student teaching and research.

The Research and Educational Hospitals, planned and built for teaching and investigation, connect directly with the classrooms and laboratories of the Colleges of Dentistry and Medicine. The addition, completed in 1953, increased the total capacity of the Research and Educational Hospitals and the Neuropsychiatric Institute to 810 beds. Each year there are approximately 200,000 patient visits in the outpatient clinics and 12,000 admissions to the hospitals. There are eleven surgical operating rooms, all with facilities for students and some equipped for special procedures. All types of surgery, including dental, are practiced.

The facilities of the Aeromedical unit include rooms and an altitude chamber in which ranges of temperature, humidity, and pressure can be

controlled, and basic medical and physiological instruments. They are available for use by any department or division of the University needing controlled environmental conditions for special research or instructional work.

The Drug Plant Experiment Station, located at Lisle, Illinois, provides unique opportunity for the development of drug plant research.

LIBRARY OF MEDICAL SCIENCES

The library contains a comprehensive collection of standard and modern works in subject fields of interest to dentistry, medicine, nursing, pharmacy, and social work students. Some 1,700 periodicals are being received regularly, and the library's resources include more than 141,000 volumes. Its facilities are available for reference use, and most materials may be withdrawn for use outside the reading rooms.

MUSEUMS

The College of Dentistry has a museum for the study and demonstration of the ecology of the masticatory structures, containing over 1,000 specimens.

The College of Medicine has two museums: the Anatomy Museum, including exhibits relating to gross anatomy, histology, embryology, and neurology; and the Pathology Museum, including gross specimens for purposes of instruction of undergraduate and postgraduate students of medicine and dentistry.

The College of Pharmacy has a museum including more than 10,000 specimens of crude drugs and technical products. One collection is classified according to botanical origin and is arranged in cases illustrating habitat, commerce, etc. Another collection contains every drug officially listed in the *United States Pharmacopocia* since 1820 and in the *National Formulary* since 1888.

RECREATIONAL FACILITIES

The social and recreational center for students, alumni, and faculty members is the Chicago Illini Union Building, 715 South Wood Street. Its facilities include a cafeteria, grill, soda fountain, browsing room, music room, gymnasium, meeting rooms, and game rooms. Intramural sports under a trained director are encouraged, and facilities and equipment are available for softball, touch football, horseshoes, tennis, archery, wrestling, fencing, badminton, basketball, handball, and table tennis. Through special arrangements, the swimming pools of the nearby Y.M.C.A. and Y.W.C.A. are available to students. An annual golf tournament is held at a nearby golf course.

STUDENT HOUSING

Rooming facilities are available in University residence halls. Inquiries



should be addressed to the Director of Housing, University of Illinois, 818 South Wolcott Avenue, Chicago 12, Illinois.

REGISTRATION AND PROGRAM OF STUDIES

Registration. Graduate students must register at the beginning of each quarter. Initial registration is permitted only after a student's application has been approved by the Graduate College. Information concerning acceptance may be obtained at the Graduate College office after the application has been processed.

Upon acceptance, a student obtains registration forms and instructions in the Graduate College office and is assigned his major adviser, with whom he discusses his program of study and research. After obtaining the signature of the major adviser, the student obtains the signature of the instructor for each course. The registration forms are then submitted to the Associate Dean of the Graduate College for approval.

Admission to graduate courses is granted only to persons who have the requisite undergraduate work. The candidate registers for a certain number of graduate units. Each unit represents thirteen hours of laboratory work, or the equivalent, a week. One-half unit may be taken as the minimum each quarter, and three units constitute a full program.

Registration, including the payment of fees, must be completed before the close of the regular scheduled day for this purpose.

Change of Program and Withdrawal. A graduate student is expected to plan his work carefully. When a change seems advisable, it may be permitted if approved by the major adviser, the instructors involved, and by the Associate Dean of the Graduate College. Simply ceasing to attend class does not constitute official withdrawal. If a student wishes to drop a course or to add other work, he must first secure an official change slip from the office of the Graduate College. Changes in program are permitted without fee if completed by a specified date. After the indicated date a fee of \$1.00 is charged for each change. A student is not permitted to drop a course after the term is half finished if his grade in that course is C or below, unless he is willing to accept a grade of E therein. Exceptions may be made by the Associate Dean when justified.

A student who wishes to withdraw from the University must obtain a clearance form at the office of the Graduate College.

Change in Major Subject. A student who wishes to transfer from one department to another must secure and present to the Associate Dean the written approval of his present major department.

Unit Credit for Courses. Courses numbered from 300 to 399 are open to advanced undergraduate and graduate students, and those numbered

400 and above are open to graduate students only. Courses numbered below 300 do not carry graduate credit.

Graduate credit is measured in terms of units. One unit is considered the equivalent of five quarter hours. The maximum program for a full-time graduate student is three units each quarter.

Courses Taken at Other Institutions. Students desiring to register for a course at another institution may do so only with the approval of the major adviser. If credit is to be used to meet requirements for a graduate degree, written approval of the adviser and the head of the department of the discipline involved must be presented to the Associate Dean of the Graduate College prior to registration for the course. When the course is completed, the appropriate amount of credit is accepted and recorded upon receipt of a transcript.

Graduate Study by Medical Students. At the completion of his first year in medicine, a student who has been in residence for one year and has maintained a B or 4.0 average in the College of Medicine for three quarters of medical work, may be permitted to register for three-fourths unit of graduate work each quarter concurrently with a full program of medical courses and for a full program of graduate work in the summer quarter. Only students of excellent record are allowed this privilege. Registration may continue in following quarters as long as a 4.0 average is maintained in the medical curriculum.

Medical students who take advantage of this opportunity become familiar with the methods of research and advanced study and are granted credit by specialty boards for the basic science time credit requirement. Courses credited toward a professional degree can not be used for duplicate formal credit toward a graduate degree; however, recognition is given to the extensive program of basic science courses pursued in the medical curriculum and a lesser program of formal graduate courses is accepted for the M.S. and Ph.D. degrees (see details under degree requirements).

Medical students who wish to register for a full-time program of medical work or graduate work in alternate quarters must submit a program of study in advance for approval by the Associate Dean, noting the work to be taken in each quarter. In the case of assistants, the percentage time of employment should be noted in those quarters when service is to be rendered to the department.

Graduate Study by College Seniors. A college senior who has been in residence for at least three quarters and who is within five semester hours of his bachelor's degree may be admitted to the Graduate College if his grade-point average for the last 50 per cent of the hours completed is approximately 4.0. Seniors who meet these requirements and who wish to

apply should submit an application for admission together with a letter from the dean of the undergraduate college specifying the hours needed to secure the bachelor's degree. If admitted to the Graduate College, the student carries as miscellaneous course work the hours needed to complete the requirements for the first degree; in addition, he registers for courses to be credited toward an advanced degree.

A senior who is within ten hours of the bachelor's degree may register in graduate courses for graduate credit if his grade-point average is that specified above and if he secures the approval of the head of the major department and the instructors concerned.

Graduate Study by Members of the Staff. Academic or nonacademic employees whose departmental head or director requests that they take a course to improve their potential services to the University register for those courses as "visitors" without formal credit toward a degree. Assistants, research assistants, residents, interns, and others on the University staff who undertake graduate study can not expect to complete requirements for a degree as promptly as those who devote full time to their academic work. The academic programs of assistants and others on the University staff are limited by statute, and exceptions are permitted only occasionally for advanced students who can show compelling reasons for such deviation. Those employed outside the University are expected to reduce their programs of academic work in accordance with these regulations. The maximum amount of work allowable is determined in accordance with the terms of employment as follows:

Full-time employment	¾ unit
Three-quarter time employment	1½ units
One-half time employment	2 units
One-quarter time employment	2½ units

Individuals on the academic staff are not admitted as candidates for an advanced degree if they hold an appointment as Professor, Associate Professor, Assistant Professor, or Research Associate in any department or division of the University. Any person engaged in graduate study who accepts an appointment with the rank of Research Associate or higher is dropped as a degree candidate.

Graduate Study in the Summer. A full term of work is available during the summer quarter. Medical, dental, and pharmacy students may register for full-time graduate work during the summer, provided they qualify for registration.

Time Limit for Completion of Degree. A candidate for the master's degree must complete all requirements for the degree within five calendar years after his first registration in the Graduate College and a candidate

for the doctor's degree within seven years after his first registration in the Graduate College, except as noted in the next paragraph.

A candidate for the doctorate who has received a master's degree elsewhere must complete all requirements for the degree within five years after his first registration in the Graduate College. This same regulation applies to the candidate who has received his master's degree from the University of Illinois and whose studies were interrupted immediately thereafter, but not more than the minimum number of units required for the master's degree may be applied to the doctorate.

Grades. Grades are recorded as follows: A, B, C, D, and E. A grade of E indicates a failure, and a grade of C or D indicates unsatisfactory, though passing, work. A student at the Master of Science level who receives a grade below B in more than one unit must complete additional equivalent course work and units with A or B grade, to qualify for a degree. Three units of a grade below B disqualify a student for further work at the Master of Science level. In pursuit of formal courses toward the Ph.D. degree, a grade of C is validated toward unit and formal course requirements by a grade of A in a formal course of equivalent credit. Three units of uncompensated C grades disqualifies a student for further registration.

A student is automatically placed on probationary status when he has acquired two units below a B grade. Such status appears on his transcript of record.

A failure or absence from an examination in any course in the major field precludes the conferring of the degree in the year in which the failure occurred.

Attendance at Commencement. Candidates for graduate degrees are expected to attend Commencement exercises in June.

Petitions. The normal procedures and requirements of the Graduate College are indicated in this catalog, but these may be modified occasionally for justifiable reasons. A student may petition the Associate Dean and the Executive Committee of the Graduate College for exceptions, but he should do so only after consultation with his adviser.

Advisers. Every graduate student must have an adviser. The adviser's primary duty is to assist the student in planning and carrying through a program of graduate work which fits the needs and desires of the student, and at the same time satisfies departmental and Graduate College requirements. A new graduate student should go to his major department to discuss the selection of an adviser.

Transfer of Credit. A graduate student who has completed graduate courses elsewhere may petition for transfer of credit. Such a transfer must not exceed three units of work and must have the recommendation of the

head of the department in which the student is pursuing his program and the approval of the Associate Dean. In such instances the head of the department must be satisfied that the work is equivalent to the level of graduate courses offered by the University of Illinois. The petition is not considered until the general residence requirement of three quarters is fulfilled.

THE DEGREE OF MASTER OF SCIENCE

The program for the Master of Science degree permits the superior student to explore intimately the subject matter of his major area of specialization and provides him with an opportunity to develop research competence. The Master of Science degree may be terminal, or the course of study and research may be designed to serve as the foundation for a more advanced scholarly undertaking leading to the Ph.D. degree. The Master of Science program should involve a program of research culminating in a satisfactory thesis.

Study Program — Minimum Formal Requirements for the M.S. Degree

Laboratory research	2 units
Formal courses ¹	3 units
(including 1 unit in 400 series)	
Seminars and electives	4 units
An acceptable thesis	
Sustain an oral examination	

Three units constitute a normal quarter program. Nine units must be completed for the degree. At least four units of the total of nine must be in the major discipline.

Medical students or medical graduates will be required to absolve only one unit of 400 series formal courses (since they have completed or will have completed nineteen units of basic science formal graduate courses in the 300 series in their medical curriculum). A minimal program for these students therefore could be one unit of 400 series formal courses and eight units of research and seminar courses.

Residence Requirements. A candidate for the master's degree is required to be in residence for the equivalent of at least three quarters. A student is in residence only when registered in the Graduate College and spending full time on the campus. Such a student earns full residence if he is registered for at least two units. Students in residence who are carrying lighter programs of work must spend a proportionately longer time in satisfying this requirement; thus, for example, a full-time assistant registered for three-fourths unit each quarter would discharge the residence requirement in six quarters. The time required to complete residence re-

¹ Seminars and research courses are not considered "formal courses."

quirements and to attain the Master of Science degree is referred to as the “first year” of graduate study.

Foreign Language. A foreign language is not required for the Master of Science degree, but students contemplating work for the doctor’s degree should make arrangements to satisfy requirements in one foreign language while they are candidates for the Master of Science degree. Satisfactory demonstration of knowledge of one foreign language must be completed before unit credit is allowed toward a Doctor of Philosophy degree.

Thesis. A candidate for a master’s degree must submit a thesis on a subject approved by the professor in charge of his major work. Such approval must be secured, and the subject of the thesis filed at the office of the Graduate College not later than the beginning of the last quarter of residence, at which time a thesis advisory committee will be appointed.

Thesis Work in Absentia. A student may be permitted to complete the last two units of his work, if devoted to his thesis, under leave of absence. To receive such permission, the student must have accumulated at least seven units in residence, must petition for the privilege, and must submit to the Executive Committee an outline of the proposed investigation approved by the head of his major department and satisfactory evidence that adequate facilities are available at the place where he intends to do the proposed work. If the petition is approved, the student must register for not more than one unit per quarter, pay tuition fees, and discuss his progress with his major adviser at frequent intervals.

Thesis Preparation. Specific written instructions for the preparation and form of the thesis are available at the Graduate College office. Special thesis paper is required, and title pages and envelopes must be printed. Two copies of the approved thesis are required, one for the University Library at Urbana and the other for the Library of Medical Sciences at Chicago. The thesis may be submitted at any time during the year; however, candidates who expect to receive a degree in June must meet the deadline indicated in the Calendar.

Oral Examination. Upon deposit of the thesis, a committee is appointed by the Associate Dean to examine the thesis and to determine the candidate’s knowledge in the major and minor fields of study. Degrees are conferred at the June Commencement. Candidates must be recommended to the Associate Dean for the degrees indicated at least two weeks before the date set for the Commencement exercises (see Calendar).

Publication of the master’s thesis is encouraged and does not require prior approval of the Graduate College.

Applications for Degrees. Each candidate for the degree of Master of Science must file an application for the degree on a blank provided for

that purpose. For the dates of application and deposit of theses, consult the Calendar.

THE DEGREE OF DOCTOR OF PHILOSOPHY

Admission. Students desiring admission to graduate study beyond the Master of Science degree must file an application with the department of choice. Students who have completed the Master of Science degree or those who have completed satisfactorily one academic year of graduate study and desire to pursue a formal program toward the Ph.D. degree shall indicate this desire to their major adviser. Previous to registration of the student, for work toward the Ph.D. degree, a committee composed of the student's major adviser as chairman and two additional members of the graduate faculty, chosen by the major adviser or the department head, will arrange an interview with the student and outline a program of formal courses, seminars, foreign language examinations, and other requirements in an integrated whole relevant to the objectives of the student and his major adviser; the program as outlined shall be recorded in the Graduate College and is subject to alteration at the discretion of the original committee. A student must have passed or be prepared to pass an examination in one of the required foreign languages at the time of admission for work at the Ph.D. level.

Transfer Students with Degree of Master of Science. Upon the recommendation of the head of the department of the major field of study and with the approval of the Associate Dean of the Graduate College, admission with advanced standing is granted to applicants who have completed a master's degree or the equivalent elsewhere and who desire to become candidates for the doctor's degree at the University of Illinois. If the applicant is admitted, his year of advanced study completed elsewhere is accepted as one year of residence, and the amount of credit to be accumulated at the University of Illinois shall be determined by the committee for the qualifying interview. In any case it shall not be less than eighteen units.

Study Program — Minimum Formal Requirements for the Ph.D. Degree

- Formal 400 series courses..... 3 units
(Two units must be in the area of the major discipline and one unit must be in the area not directly related to the major discipline)
- Research, seminars, and elective formal courses.....24 units
- Reading knowledge of two of the following languages:
French, German, or Russian (substitutes by petition)
- Sustain the oral preliminary and final examinations
- An acceptable thesis

Courses completed in the M.S. program will be counted toward the total unit requirements for the Ph.D. degree. More than ten units of formal courses will be allowed only by petition.

For those basic medical science departments where the departmental requirements make it mandatory for the student to pursue three or more units of 300 series courses as prerequisites for more advanced work, any units earned in excess of three units in 300 series in medical basic science courses may be counted as 400 series courses up to a maximum of one unit provided the excess unit is in an area outside the major discipline. A minimum of two units of 400 series formal courses originally approved as such and listed as 400 series formal courses must be absolved by every candidate for the Ph.D. degree and one such unit of 400 series formal courses must be completed for the Master of Science degree.

The program for the Ph.D. degree does not require a formal minor but substitutes for it formal course work in an area not directly related to the major discipline. A student may, at his option, declare a formal minor and absolve the usual requirements of four units, two units of which must be in formal course work. A split minor is not allowed. The minor must be selected in a discipline which has an approved curriculum leading to the Master of Science degree.

Registration in Basic Medical Science Courses. Upon recommendation of the major adviser to the Associate Dean, a student may pursue, without unit credit, basic science courses not specifically required in the Doctor of Philosophy program. Grades obtained in such courses are not prejudicial to the student's standing in the Graduate College. It is obvious, however, that unsatisfactory grades may be detrimental to his general progress and standing in the area of his major and minor departments as determined by those departments.

The privilege of registering for additional basic science courses as stated above is curtailed if it appears that the student's intent is to meet the requirements of the medical curriculum thereby. Registration is not allowed for more than one such course each quarter on this basis.

Language Requirements. A candidate is required to demonstrate ability to read two of the following languages: French, German, or Russian. The language requirement should be satisfied early in the doctoral program, in any event not later than two months prior to the preliminary examination, or during the summer preceding admission to the preliminary examination. A student must satisfy the language requirement by direct examination. Certification of proficiency in foreign languages is not accepted from other colleges or universities.

Period of Study. The normal minimum period of study required for the degree of Doctor of Philosophy is two years beyond the master's degree,

during which the student is required to devote all of his working time to his studies. Both years must be spent in residence at some accredited educational institution. If the student has obtained his Master of Science degree at the University of Illinois and obtains the approval of the Executive Committee, one of the two years may be spent in absentia. A student who has completed the first year of graduate work elsewhere must be in residence during the two remaining years. In exceptional cases, a student with two years of graduate study elsewhere who satisfies his major department that he has completed work equivalent to the standard departmental requirements is permitted to take his preliminary examination, provided he has fulfilled the language requirements. If such a student passes the preliminary examination, he may complete the requirements for the Doctor of Philosophy degree by devoting the third year to research in residence. The degree is conferred, however, not for residence during a certain period, but for scholarly attainments and power of investigation, as proved by a thesis and examination.

Residence Requirements. A student is in residence only when registered in the Graduate College and spending full time on the campus. Such a student earns one quarter of residence if he is registered for two or more units. Students in residence who are carrying lighter programs of work must spend a proportionately longer time in satisfying this requirement.

Continuous Registration for Zero Credit. A candidate for the Doctor of Philosophy degree who has passed the preliminary examination, has fulfilled all formal course requirements, and has attained a total of at least twenty-seven units is nevertheless required to continue his registration in the Graduate College until he has passed the final examination. Such students must register for zero credit and pay a flat fee each quarter whether on the campus or in residence elsewhere.

Preliminary Examinations. A candidate for the Doctor of Philosophy degree must pass a preliminary examination intended to test his knowledge of his major and related fields of study and to determine whether he is prepared for the final year of work. He is eligible to take the examination when (1) he has completed a Master of Science degree or has the approval of the Executive Committee to bypass this degree; (2) he has passed the two required language examinations; (3) he has satisfactorily completed nine units of work beyond the master's degree or a total of 18 units of graduate work and all of the non-research courses prescribed by the qualifying committee; and (4) his adviser informs the Associate Dean that the candidate is adequately prepared.

The examination extends to the candidate's whole field of study. It is not confined to specific courses taken in this or other universities, but is conducted to determine whether the candidate has mastered a definite field

of knowledge and is able to evaluate its potentialities and opportunities for further advances. The student must also satisfy the committee that he is able to integrate his field of specialization with the larger domains of knowledge and understanding. The examination is partly oral, and may be wholly so.

The student must complete two full quarters of residence between his preliminary examination and the completion of his work for the doctorate.

Other Examinations. Before the candidate is admitted to the final examination and defense of his thesis, he may be required to take any other examination, oral or written, which is thought proper by the various departments in which he has studied.

The above examinations are in addition to those in the courses for which the student is registered, and must be taken at the times set by the major adviser.

Final Examination. At least two weeks before the time when the degree is conferred, the candidate must submit to a final examination given by a committee appointed by the Associate Dean. This examination is primarily on the research work of the student as embodied in his thesis and is conducted chiefly to determine if the candidate has demonstrated the capacity to do original and independent scholarly investigations in the field of his choice, but is not confined to that alone. It is intended to varify also that the candidate has a satisfactory grasp of his major subject as well as an acquaintance with the field of knowledge pertaining less directly to it.

A department may elect to forego the customary final Ph.D. examination and substitute in its place an open departmental seminar at which one or more candidates will present the results of their investigations together with related scholarly material. In addition to the members of the thesis committee who attend, faculty from other departments, graduate students, and other interested parties may attend. While the seminar will take the nature of a ceremonial event rather than an examination in the usual sense, the candidates may be expected to withstand critical interrogation by members of the thesis committee or others present.

Thesis. The ability for independent research must be shown by the production of an original thesis on some topic connected with the major field of study. The candidate is expected to defend his thesis or dissertation before the members of the faculty, or as many of them as may wish to question him about it, in connection with his final examination.

The subject of the thesis should be chosen and the title submitted to the Graduate College office not later than the first registration following successful completion of the preliminary examination, at which time a thesis advisory committee is appointed.

Not later than two weeks prior to the final examination, and not less

than four weeks before the time when the degree is to be conferred (see Calendar), two typewritten copies of the complete thesis and an abstract on thesis paper and in final form with title pages, envelopes, and certificates of approval, must be deposited in the office of the Graduate College. The style and form of the thesis and abstract must comply with the written instructions obtainable at the Graduate College office. After the thesis is checked in the Graduate College office, the student must arrange for each member of his doctoral committee to read the thesis before the date of the final examination.

Certificates. Each of the copies of the thesis must be accompanied by a certificate of approval. The certificate forms are available in the Graduate College office and must be signed by the person under whose immediate supervision the thesis was prepared and also by the head of the major department. In considering the deadline for submitting the thesis and abstract to the Graduate College in its final form, the adviser and student should allow the head of the department sufficient time to review both the abstract and the thesis before affixing his signature of approval to the certificates. These certificates must also be signed by the members of the examining committee immediately following the oral examination.

Microfilm Reproduction. In order to insure that theses are available for use by others, they must be microfilmed. Each candidate who passes the final examination must pay a fee of \$25.00 and deposit a typewritten abstract of his thesis of approximately six hundred words, together with the original and first carbon of the complete thesis. This fee provides for (1) microfilming of the complete dissertation, with one copy deposited in the University of Illinois Library, (2) publication of an abstract of six hundred words or less in *Dissertation Abstracts*.

The abstract must indicate the method followed, the evidence used, and the conclusions reached in the investigation, and must follow the form generally used for publication of abstracts.

Publication of Thesis. Formal publication of the thesis, either in its entirety or in a condensed form, is not required. However, students should consider the advantages to them, and to their professional field, of publication of the significant methods and findings of their research in the technical literature. If published, the article or book should have a note indicating that the material is, or is based upon, a dissertation submitted in partial fulfillment of the requirements for the Doctor of Philosophy or Master of Science degree at the University of Illinois.

Application for Degree. Each candidate for the Doctor of Philosophy degree must file an application for the degree on a blank provided for that purpose. Application is made at the time the thesis is submitted in final form to the Associate Dean. Degrees are conferred in June.

FINANCIAL ASSISTANCE

Various types of financial assistance are available each year to promising graduate students in any field in which the Graduate College offers an advanced degree. Detailed information about the qualifications and application procedures for these awards is obtained by writing to the Graduate College or to any of the graduate departments.

The principal kinds of awards are as follows:

University Fellowships. University Fellowships are awarded on the basis of an all-University competition and are unrestricted as to the student's field of graduate study. Each provides a stipend of not less than \$1,800 for the academic year with exemption from tuition and all fees for the academic year and for the following summer session. University Fellows must carry a full program, three units or the equivalent.

University Teaching Fellowships. These appointments provide a tax-free fellowship stipend plus a taxable salary for service as a quarter-time teaching assistant, with the usual exemption from tuition and incidental fees. University Teaching Fellows must also carry full programs of graduate study.

Industrial, Endowed, and Special Fellowships, Teaching Fellowships, and Traineeships. Various industrial firms, foundations, government agencies, and private individuals have generously donated funds to support a number of special fellowships and traineeships for graduate students at the University of Illinois. The stipends and supplemental allowances of these fellowships are not uniform, and most of them are restricted to students in particular areas of study. Information is available in the Graduate College office.

National Science Foundation Cooperative Graduate Fellowships. These fellowships are financed by the National Science Foundation, but are administered with the cooperation of the participating universities, including the University of Illinois. They are restricted to United States citizens who are graduate students in the mathematical, physical, medical, biological, and engineering sciences and in certain other fields regarded as employing scientific methods. Each carries a stipend of \$2,200 for twelve months or \$1,650 for nine months, plus tuition and fees. An applicant for a cooperative fellowship must send his application to the university at which he proposes to pursue his graduate studies.

A recipient of a fellowship must register in the Graduate College and must pursue a program of academic study and research leading to a graduate

degree. Stipends paid to the individual are not for definite services performed for the University, but are to provide living expenses while the approved course of study or research is being pursued. Fellows must devote full time to such activities, and no teaching, proctoring, grading of papers, or other routine duties are required of them.

Fellows are selected by the Graduate Fellowship Committee on the basis of scholarship and promise in teaching or research as revealed by transcripts, letters of reference, and recommendations by the major departments. Successful applicants will receive a notice of appointment on or about April 1 and are expected to accept or decline by April 15. (See statement of policy adopted by the Association of American Universities under Assistantships on page 30.) At the time an award is accepted, the Fellow agrees that he will neither engage in any outside employment for remuneration nor hold concurrently any other fellowship carrying a stipend.

Fellows are eligible for reappointment in competition with new applicants. Fellowships provide an opportunity for research training in the basic sciences, or in the application of these sciences to clinical investigation. They are intended primarily for graduates who are in the early stages of their preparation for a teaching and research career. Fellowships are not intended to provide stipends for those fulfilling professional specialty board requirements or for those pursuing advanced work of a professional character.

Application forms may be obtained from the departments conducting graduate programs and must be submitted by March 15 for appointments which become effective on the following September 1.

Attention of all graduate students is directed to fellowship support offered by federal agencies such as the National Research Council, Washington 25, D.C., the National Institutes of Health, Bethesda, Maryland, and the National Science Foundation, Washington 25, D.C. A student should apply directly to those agencies and may obtain approval to conduct his work at the University of Illinois if accepted as a graduate student.

A number of summer fellowships are available for professional or graduate students who begin graduate programs in the summer. Stipends of \$600 are awarded to a limited number of applicants on a competitive basis. Special part-time fellowships for medical, dental, and professional students are available at \$200 per quarter on a competitive basis for those who carry a full-time professional curriculum and who qualify for research work under the direction of a faculty adviser.

SCHOLARSHIPS

Acts of the General Assembly of Illinois provide scholarships for veterans of World War I and World War II who are not receiving financial assistance for educational purposes from the federal government and who, at the time of enlistment, were residents of Illinois or students at the University of Illinois. These scholarships exempt the holders from the tuition fees in any department of the University. The General Assembly also has established one scholarship in each county for descendants of veterans of World War I and one scholarship for descendants of veterans of World War II. These scholarships are awarded by competitive examination held on the first Saturday in April.

ASSISTANTSHIPS

A number of departments offer half-time teaching assistantships at \$2,100 for the academic year. Assistants are required to perform services for the University such as grading papers, proctoring, and assisting in laboratory teaching. Half-time research assistantships are also available at \$2,570 for twelve months.

Assistants must carry a reduced study schedule as indicated on page 19 of this catalog, but the greater length of time required to complete the degree is compensated for by the additional gain in teaching and research experience. Tuition waivers are available for part-time assistants whose appointments require no more than 67 per cent time.

The University of Illinois adheres to the following resolution adopted by the members of the Association of American Universities and a number of other graduate schools of North America:

“In every case in which a graduate assistantship, scholarship, or fellowship for the next academic year is offered to an actual or a prospective graduate student, the student, if he indicates his acceptance before April 15, will still have complete freedom through April 15 to reconsider his acceptance and to accept another fellowship, scholarship, or graduate assistantship. He has committed himself, however, not to resign an appointment after this date unless he is formally released from it.”

LOAN FUNDS

Loan funds have been established for the benefit of worthy students in the University who need financial assistance. The University of Illinois also participates in the Student Loan Program under the National Defense Education Act. Application blanks for both types of loans may be secured from the Dean of Student Affairs.

FEES AND EXPENSES

Students registering for graduate work pay fees according to the following schedule:

QUARTER FEES	<i>Above Two Units</i>		<i>Above One Unit to Two Units</i>		<i>One Unit or Less</i>		<i>Zero Units</i>
	Res.	Nonres.	Res.	Nonres.	Res.	Nonres.	
Tuition ¹	\$57	\$174	\$40	\$120	\$25	\$ 75	\$10
Service Fee ²	27	27	24	24	19	19	15
Hospital-Medical-Surgical Insurance Fee ³	6	6	6	6	6	6	6
<i>Total</i>	<u>\$90</u>	<u>\$207</u>	<u>\$70</u>	<u>\$150</u>	<u>\$50</u>	<u>\$100</u>	<u>\$31</u>

SPECIAL FEES

Late Registration Fee.....\$15.00

Former students who register after the regular registration days are subject to this fee.

Change of Program Fee..... 1.00

This fee is charged for every change slip issued after a specified date at the request of the student.

Special Examination Fee..... 10.00

This fee is charged for any special examination given in a course which has been failed.

Transcript Fee 1.00

Each student who has paid all his University fees is entitled to receive, without charge, one transcript of his record. For each additional transcript the fee is \$1.00.

Service Charge for Deferred Fees

Tuition and fees for each quarter may be paid in three installments, one-third payable at registration, and one-third in each of the following two months.

Students electing the installment plan for payment of tuition and fees are assessed a \$2.00 service charge.

Fees for Medical and Dental Students

Students registered concurrently for graduate work and full-time dental or medical work are exempt from graduate fees.

Fees for Persons on the University Staff

Members of the academic staff of the University of Illinois may register in University courses without payment of the tuition fee and service fee, provided that their annual appointment specifies not more than 67 per cent time and not less than 25 per cent time service to the University.

Academic or nonacademic employees whose department head requests that they take a course to improve their potential for service to the University shall

¹ Except those holding exemptions.
² Persons on the academic, administrative, or permanent nonacademic staff of the University, or on the staffs of the allied agencies, and persons registered in absentia or off-campus are exempt from the Service Fee.
³ Students presenting evidence of equivalent coverage may receive a waiver of the Hospital-Medical-Surgical Insurance Fee upon approval of a petition submitted to the University Insurance Office not later than the final day established for full refund of fees. Persons registered for thesis research in absentia are not assessed the Hospital-Medical-Surgical Insurance Fee.

register for those courses as “auditors.” Such registrants are fee exempt under certain conditions.

WITHDRAWAL (all colleges)

A student subject to tuition and/or fees who withdraws from the University during any term receives refunds as follows:

a. *During the first ten days in the quarter*, refund is made of the full amount of the tuition and fees assessed except for a nonrefundable charge of \$20.00.¹ When the total assessment has been less than \$20.00, the full amount of the assessment, if any, is nonrefundable.

b. *After the first ten days but within the first half of the quarter*, one-half of the total amount of the tuition and fees assessed which remains after deduction of the above mentioned amount is refunded.

c. *After the midpoint of the quarter*, no refund is allowed.

REDUCTION OF PROGRAM

A student who reduces his registration to a lower range receives a refund of the full amount of the difference in tuition and fees specified for such schedules provided the changes are made during the period designated for refund of full fees in case of withdrawal from the University. One-half the above difference is refunded if the changes are made during the period for one-half refund in case of withdrawal from the University. Thereafter, no rebate is allowed.

¹ The nonrefundable charge includes the Hospital-Medical-Surgical Insurance Fee, if originally paid, and the student who withdraws from the University continues to be covered by the insurance until the close of the term. The remainder of the retained amount is allocated first to the Service Fee and then to tuition.

FIELDS OF INSTRUCTION LEADING TO MASTER OF SCIENCE AND DOCTOR OF PHILOSOPHY DEGREES

Courses open to graduate students are of two classes. Those numbered from 300 to 399 are open to advanced undergraduate and graduate students. Those numbered 400 and above are open to graduate students only.

Many courses for graduate students require some measure of previous preparation. A student who wishes to enter a particular course must satisfy the department concerned that he has had, either at the University of Illinois or elsewhere, the necessary preparation for admission to the course.

The credit value of graduate courses is given in units. Quarters in which courses are taught are indicated by F, W, Sp, or S representing fall, winter, spring, and summer, respectively.

Anatomy

The fields of study open to a student in the Department of Anatomy are human anatomy, cellular biology, endocrinology and reproduction, growth and development, and neuroanatomy.

Application is made by an interested student to the Chairman, Graduate Program Committee, Department of Anatomy. This Committee will review transcripts, recommendations, and other pertinent information as a basis for selection of graduate students. A limited number of students can be accepted each year. Financial support, including tuition, may be available for all, or most, students.

The Department prefers to accept only those students who intend to complete a doctoral program. Usually the program incident to fulfilling requirements for the master's degree is directly related to the continuing doctoral program, and by the time the master's degree is conferred, most of the formal course requirements for the Ph.D. degree are fulfilled. Exceptional students may, after completing one academic year of graduate work, with the approval of the Graduate College, proceed directly toward a Ph.D. degree; otherwise the master's degree is required. Knowledge of a second language is strongly recommended at the time of entrance, since reading knowledge of two languages is required of all candidates for the Ph.D. degree. German, French, or Russian are usually presented, although another Teutonic or Romance language may be accepted with the approval of the adviser and the Graduate College.

The master's thesis must give evidence that the student has engaged in a satisfactory research experience involving planning, observing, collecting, and evaluating experimental evidence, and relating it to the literature of the field.

The doctor's thesis must give evidence of scholarship and research ability. A doctor's thesis must: (1) establish a new and useful method for gathering

original data; (2) give evidence for, or in support of, a new hypothesis or theory; or (3) give firm evidence for, or against, a hypothesis which is of doubtful validity.

The goal of graduate training in anatomy is: (1) to train competent teachers for all phases of medical school anatomy; and (2) to develop research-minded scholars who are prepared to engage in effective creative work in some field of experimental biology.

General Plan for Graduate Study

The beginning graduate student is assigned an adviser by the Chairman of the Graduate Program Committee. He enrolls in the medical courses in gross anatomy, microscopic anatomy, and neuroanatomy. Successful completion of this program yields six units of work in 300-level courses. In addition, all new students in the fall and winter quarters enroll in courses 421 and 422, Techniques of Anatomical Research, and in 410 and 411, Concepts of Morphology: Cytology. Students who may have had comparable courses in other institutions may be excused from taking the course but be required to take all examinations.

The program of orientation in techniques and ideas is one in which students have contact with most, or all, of the teaching staff. By means of this, a student becomes familiar with fields of study open to him in the Department. By the end of the winter quarter, he earns two units of 400-level course credit. In the spring, the student elects his field of research and may prepare to begin research under an adviser with special interest in that field.

During the summer a full-time student engages in research for three units of credit, or he may combine research for two units with the course in biometrics for one unit.

Subsequent research and course work is planned in conjunction with the adviser under whom, by this time, the student has arranged to continue his studies. The second academic year includes additional advanced courses in anatomy, and courses in biochemistry, physiology, or other areas collateral to his area of research. Research should be the principal interest of a graduate student during his second year and thereafter.

All graduate students assist in teaching after the first year. By the time they finish, they have assisted in each of the professional courses when they receive the Ph.D. degree.

A journal club meets once a week under the supervision of a faculty member. Departmental seminars are likewise attended by all graduate students. No graduate credit is given for these activities. If the research work of a student will benefit by doing research or taking courses in Chicago museums or other universities, such arrangements are made. Work in sum-

mer biological stations is encouraged where this benefits the program of a student.

In addition to fulfilling the stated requirements of the Graduate College for candidacy for the Ph.D. degree, a graduate student is required to take a departmental written examination in anatomy, prepared and administered by the staff of the Department. It is expected that upon successfully passing the preliminary examination, the thesis will be submitted in rough draft to the adviser, complete with respect to all research work, by the beginning of the quarter in which the degree is to be conferred.

Financial support, including tuition, fees, and certain allowances for dependents, is available. University Fellows and most assistants do not pay tuition. Application for financial support is made at the time of application for admission to the College. The Graduate Committee of the Department decides the level of trainee stipends and allowances; the Department Head, in consultation with the staff, recommends candidates for assistantships. University Fellows are appointed by the Graduate College upon application.

GRADUATE TEACHING FACULTY

Professors: SAMUEL R. M. REYNOLDS (Head of Department), LLOYD E. DuBRUL, MILTON B. ENGEL, ROBERT H. KREHBIEL, JAMES C. PLAGGE, ISAAC SCHOUR, PARKE H. SIMER.

Associate Professors: LUIS M. H. LARRAMENDI, ARTHUR LAVELLE, HARRY MONSEN, ANTHONY J. SCHMIDT.

Assistant Professors: VINCENT J. DEFEO, CHARLES W. HUVER, EDITH K. MACRAE, HELEN C. MAIBENCO, PIERSON J. VAN ALTEN.

COURSES FOR GRADUATES

301. Gross Human Anatomy. Regional and systemic dissection of the human body. Functional and applied considerations. F, W, Sp; 3 units (1 unit each quarter). Staff.

302. Human Histology. Morphology and functions of cells and fundamental tissues. Laboratory and conferences. F, W; 2 units (1 unit each quarter). Staff.

303. Human Neuroanatomy. Anatomy and functions of the human nervous system; architecture of the nervous system and the functions of the nervous pathways. Laboratory and lectures. Sp; 1 unit. Staff.

350, 351, 352. Clinical Anatomy. Advanced anatomy. F, W, Sp; (½ unit each quarter). Staff.

410. Concepts of Morphology. Weekly group discussions of development of concepts in anatomy in selected areas. Three hours (once weekly). F; ½ unit. Staff.

411. Concepts of Morphology. Continuation of Anatomy 410. W; ½ unit. Staff.

412. Concepts of Morphology. Continuation of Anatomy 411. Sp; ½ unit. Staff.

421. **Techniques in Anatomical Research.** Technical procedures currently used and taught on a demonstration and practice basis by the staff. Includes cytological, tissue culture, electron microscopy, surgical, histological techniques, and other procedures. F; ½ unit. Staff.
422. **Techniques in Anatomical Research.** Continuation of Anatomy 421. W; ½ unit. Staff.
423. **Techniques in Anatomical Research.** Continuation of Anatomy 422. Sp; ½ unit. Staff.
430. **Reproductive System.** A lecture and laboratory course dealing with the role of the nervous and endocrine systems on the anatomy, biochemistry, and physiology of reproduction in experimental animals. F (alternate years); 1 unit. DeFeo.
431. **Experimental Neurocytogenesis.** This course is concerned with the factors underlying the inductance, differentiation, and subsequent maturation of the vertebrate neuron. The genesis of behavioral patterns, of organelles, and of certain enzyme systems will be considered also in relation to neuronal development. Sp (alternate years); ½ unit. LaVelle.
433. **Experimental Morphogenesis.** An analysis of problems in the development and organization of animal eggs, with reference to polarity, symmetry, induction, and topogenesis. Special consideration is given to problems in fertilization, organization of the vertebrate body axis, fields and organogenesis, regulation, and regeneration. W or Sp (alternate years); ½ unit. Schmidt.
491. **Seminar in Anatomy.** Presentation and discussion of individual investigations by members of the department and others; reviews of important contributions in morphologic investigation. F, W, Sp; ¼ unit each quarter. One seminar presentation a year required for credit. Staff.
493. **Research in Anatomy.** F, W, Sp, S; ½ to 3 units each quarter. Staff.

Biological Chemistry

The Department of Biological Chemistry has an active graduate training program with adequate facilities for graduate students pursuing work toward the Master of Science and Doctor of Philosophy degrees.

The objectives of the Department of Biological Chemistry in offering graduate training are: (1) to develop teachers of the subject for universities and for colleges of medicine, dentistry, and pharmacy; and (2) to develop investigators in this field and the allied biological sciences.

In general, the admission requirements are those which apply to all applicants for graduate work at the Medical Center. Since the approach to biological chemistry may be either primarily chemical or biological, the requirements for graduate work in the department are flexible enough to permit admission of individuals of quite different backgrounds. The undergraduate training should include sixteen semester hours of chemistry, in-

cluding organic, quantitative analysis, and physical chemistry; eight semester hours of physics, including laboratory work in electricity, heat, mechanics, and sound; at least one thorough course in biology; and at least six semester hours of German or French. If an applicant's undergraduate preparation is deficient, certain of these courses may be pursued without graduate credit after admission to the department. Students having a bachelor's degree, including the above minimum course requirements, as well as medical and dental graduates or students pursuing these professional degrees, are eligible to apply for graduate work in the department.

Candidates for the Master of Science degree in biological chemistry are required to complete nine units of work. As part of these nine units, candidates are required to take at least four units in biological chemistry, including Biological Chemistry 301, 302, 410, 491 (one-half unit), 493, and at least one-half unit more of an advanced course (400 series) offered by the Department. At least one unit of the nine must be taken in formal courses offered by other departments (Anatomy, Chemistry, Microbiology, Pathology, Pharmacology, or Physiology).

Candidates for training beyond the degree of Master of Science must have earned this degree or met the requirements for the degree in the Graduate College or have completed work of equivalent values elsewhere. Students in good standing are encouraged to proceed directly to the Ph.D. degree without obtaining a M.S. degree. To do this, a student is required to have completed nine units of graduate work, passed the reading examination for one language, and passed an oral Qualifying Examination given by the Department.

The requirements for the Degree of Doctor of Philosophy include Biological Chemistry 301, 302, 410, 491 (one unit), 493 (nine units), and two 400 series courses; one unit of another basic science course; Chemistry 301, 335, 336, 346, and two 400 series courses. The remaining courses must be selected to complete the requirements of eighteen units beyond the master's degree.

A minor in biological chemistry includes Biological Chemistry 301, 302, 491 (one-half unit) and at least one unit of formal 400 level courses in the Department.

The thesis and language requirements must conform to the general requirements of the Graduate College, and the thesis must be of sufficient merit to warrant publication in full or in part in a recognized scientific journal.

GRADUATE TEACHING FACULTY

Professors: RICHARD J. WINZLER (Head of Department), STEPHEN B. BINKLEY, M. K. HORWITT, M. E. RAFELSON, JR.

Associate Professors: LEO G. ABOOD, HENRY JEFFAY, CLARENCE A. JOHNSON,
PAUL KOHN, TERRELL C. MYERS, BERNARD WEISSMANN.

Assistant Professors: JAMES A. HAYASHI, HOWARD SKY-PECK, EDWARD B. TITCHENER.

COURSES FOR GRADUATES

- 301. Biological Chemistry.** Discussion on the chemistry of the constituents of tissues and body fluids, digestion, absorption, and intermediary metabolism of lipids, proteins, and carbohydrates in health and disease, and the role of hormones, vitamins, and enzymes in the regulation of these processes; the application of this knowledge to the problems of disease. Lectures and conferences. F; $\frac{3}{4}$ unit. Staff.
- 302. Biological Chemistry.** Continuation of Biological Chemistry 301. Lectures and conferences. W; $\frac{3}{4}$ unit. Staff.
- 303. Biological Chemistry Laboratory.** A project type laboratory in which a small group of students work with an instructor in a limited area of biochemistry. Independence in thought and experiment is encouraged. Sp; $\frac{1}{2}$ unit. Staff.
- 401. Biochemistry of Disease.** An advanced course considering in detail the biochemical disorders that underlie or are associated with human disease. Lectures and seminars. Sp; $\frac{3}{4}$ unit. Rafelson.
- 410. Biochemical Preparations.** Discussion and laboratory work surveying and illustrating the practical aspects of biochemical methodology; techniques for the isolation, analysis, and characterization of biologically important substances; radioisotope techniques; enzyme assay. Lecture and laboratory. W; $\frac{1}{2}$ unit. Prerequisite: Biological Chemistry 301. Weissmann.
- 420. Intermediary Metabolism of Carbohydrates.** An advanced course considering in detail the chemistry and intermediary metabolism of carbohydrates. The production and utilization of energy, the enzyme systems involved, and the intermediates encountered in biological systems are considered. Lectures. F (alternate years); $\frac{3}{4}$ unit. Prerequisite: Biological Chemistry 301 and 302, or equivalent. Hayashi, Kohn.
- 421. Intermediary Metabolism of Nitrogen Compounds.** An advanced course considering in detail the intermediary metabolism of the biologically important amino acids, proteins, and nucleic acids. Lectures. W (alternate years following 420); $\frac{3}{4}$ unit. Prerequisite: Biological Chemistry 301, 302, and 420, or equivalent. Rafelson.
- 422. In Vivo Metabolism.** Studies on the metabolism of the intact organism are considered in order to evaluate the relative importance of the various metabolic pathways to the organism. Topics include: tracer methodology and biological compartmentalization theories, the nutrition, digestion, absorption, transport, storage, utilization, and relationship to other metabolic pathways of carbohydrates, lipids, and proteins with special emphasis on mechanisms controlling the rate at which each of these processes proceed. Lectures. Sp (alternate years); $\frac{3}{4}$ unit. Prerequisite: Biological Chemistry 301 and 302 (and preferably 420 or 421 and Physiology). Jeffay.
- 440. Special Topics in Biochemistry.** An advanced course dealing with selected

topics in biochemistry. The particular subjects vary from year to year. One to three topics are considered each time the course is given. Topics include: biochemistry of the hormones, chemistry and function of steroids, biochemical genetics, chemistry of enzymes, phytochemistry, etc. Lectures. Sp; ½ unit. Prerequisite: Biological Chemistry 301 and 302, or equivalent. Staff.

450. **Chemistry of Proteins.** Discussion and library work related to the chemistry and the physical properties of proteins. Lectures. F (alternate years); ½ unit. Prerequisite: Biological Chemistry 301 and 302, or equivalent. Winzler.
460. **Enzymology.** Discussion and library work related to the theory and measurement of enzyme catalyzed reactions. Lectures. W (alternate years following 450); ½ unit. Prerequisite: Biological Chemistry 301 and 302, or equivalent. Titchener.
491. **Seminar in Biological Chemistry.** Student and faculty presentation of assigned subjects of current importance in biological chemistry and related fields. Assigned reading. F, W, Sp; ½ unit each quarter. Binkley.
493. **Research in Biological Chemistry.** Research on problems of biological importance with members of the graduate staff. F, W, Sp, S; ½ to 3 units each quarter.

Chemistry (Pharmaceutical)

The Department of Chemistry offers programs of graduate education leading to the degrees of Master of Science and Doctor of Philosophy. These programs, designed to prepare qualified students for careers in teaching and research, are composed of formal courses, seminars, and research.

Admission to graduate study is subject to the general regulations and requirements of the Graduate College. The applicant's undergraduate program should include: (1) thirty-six semester hours of chemistry, including at least ten hours of general inorganic chemistry and qualitative analysis, four semester hours of analytical chemistry, eight semester hours of organic chemistry, and three semester hours of physical chemistry; (2) eight semester hours of physics; (3) six semester hours of mathematics; and (4) at least one course in biology and one foreign language.

Students possessing only the minimum credit in mathematics will be required to elect courses in analytical geometry and calculus. Highly qualified students lacking a certain entrance requirement may be admitted but will be required to remedy their deficiencies during the first calendar year in the department.

Students enrolled in the program leading to the Master of Science degree are required to elect formal courses in analytical chemistry (Chemistry 349 and 350), organic chemistry (Chemistry 301, 346, 401, and 402), physical chemistry (Chemistry 335 and 336) and medicinal chemistry (Chemistry

342). Entering students, upon arrival at the University, will be asked to participate in placement examinations which will be used solely to outline an initial program of courses. Entering students who present undergraduate or graduate credit in one or more of the previously listed courses and score satisfactorily in the placement examination may omit the course or courses from their programs. All students must, however, satisfy the course requirements of the Graduate College and must complete an acceptable dissertation based upon independent research.

Students completing the requirements for the Master of Science degree and desiring to continue study for the degree of Doctor of Philosophy are required to obtain a satisfactory score on a departmental examination covering all areas of chemistry. They must also elect at least three additional courses in the Department of Chemistry and must satisfy the Graduate College requirements for a minor or for collateral courses. The courses for these requirements may be selected from the course offerings in biological chemistry, microbiology, pharmacognosy, pharmacy, and physiology.

Students entering the Department of Chemistry with a Master of Science degree must demonstrate proficiency in the areas of chemistry represented by the requirements of this department for the Master of Science degree or must elect courses to remove their deficiencies. Such students must also secure a satisfactory grade upon a departmental examination before electing the preliminary examination.

During their first quarter in the department, students will be expected to select their research adviser and research project.

Students in other departments desiring to obtain a minor in chemistry must obtain at least three and one-half units in formal course work. One-half unit of seminar (Chemistry 491) may be elected.

The Department annually awards a number of teaching and research assistantships. Students in the department may apply for Graduate College fellowships or for American Foundation for Pharmaceutical Education fellowships.

GRADUATE TEACHING FACULTY

Professors: JAMES E. GEARIEN (Head of Department), ERNST R. KIRCH, GEORGE L. WEBSTER.

Associate Professors: MADELEINE F. BARNOTHY, LUDWIG BAUER, RALPH DANIELS, NORMAN R. JOSEPH, ALFRED J. PERKINS.

Assistant Professors: CHARLES L. BELL, DOMINICK A. COVIELLO, THEMISTOCLES P. HADJHOANNOU.

COURSES FOR GRADUATES

301. Qualitative Organic Analysis. A study of the physical and chemical properties of organic compounds, their classification reactions, and methods of synthe-

- sis of typical derivatives which lead to the identification of individual compounds. Attention is given to the separation of mixtures of chemical compounds. Two conferences and a minimum of ten hours laboratory each week. S; 1 unit. Prerequisite: One year of organic chemistry. Gearien.
304. **Phytochemistry.** Lectures, library, and laboratory work in the properties and suitable methods of isolation and purification of typical examples of plant constituents. Offered to classes of four or more students. F; $\frac{1}{2}$ to 2 units. Prerequisite: Chemistry 345 and 349. Kirch.
315. **Modern Physics.** Basic tenets of relativity and quantum theories are presented. Topics to be discussed include elementary particles, as well as atomic and nuclear structure. The biological and chemical implications of physics are stressed. Three lectures each week. Usually offered in alternate years with Chemistry 325. W (alternate years); $\frac{1}{2}$ unit. Prerequisite: One year of general physics and Mathematics 111. Barnothy.
325. **Radioactive Isotopes.** The properties and methods of the detections of radiations are discussed. The use of tracers in radiobiology, medicine, and chemistry, including the applications of therapy and health physics will be included. Methods of assaying and dispensing radioactive pharmaceuticals are emphasized. Two lectures and one four-hour laboratory period each week. Usually offered in alternate years with Chemistry 315. W (alternate years); $\frac{1}{2}$ unit. Prerequisite: One year of general physics. Barnothy.
335. **Physical Chemistry.** Atomic and molecular structure, chemical thermodynamics, phase equilibria, chemical equilibria, surface chemistry, electrochemistry, and chemical kinetics are discussed in this two-quarter course. Three class meetings each week. W; $\frac{1}{2}$ unit. Prerequisite: Three hours of physical chemistry and calculus. Perkins.
336. **Physical Chemistry.** Continuation of Chemistry 335. Three class meetings and one four-hour laboratory period each week. Sp; $\frac{1}{2}$ unit. Perkins.
342. **The Chemistry of Synthetic Drugs.** A study of modern synthetic drugs with regard to their nomenclature, methods of synthesis, and relation to other drugs having similar therapeutic properties; physical and chemical properties. Four lectures each week. W; $\frac{1}{2}$ unit. Prerequisite: One year of organic chemistry. Kirch.
343. **Chemical Toxicology.** A course concerned with the common sources; chemistry of the physiological action, methods of isolation, and identification of toxic agents commonly encountered as industrial hazards and as the cause of accidental or purposeful poisoning. Two lectures and three three-hour laboratory periods each week. Sp; $\frac{1}{2}$ unit. Prerequisite: Organic chemistry and concurrent registration in pharmacology. Kirch.
345. **Chemistry of Natural Products.** The occurrence, origin, biological significance, nomenclature, physical and chemical properties, methods of isolation, and pharmaceutical uses of important natural substances are studied. Particular attention is given to the sugars, sugar alcohols, polyhydroxyacids, gums, mucilages, pectins, glycosides, fats, waxes, sterols, hormones, vitamins,

enzymes, and essential oils and resins. Four lectures each week. W; $\frac{3}{4}$ unit. Prerequisite: Chemistry 113 and 123. Kirch.

346. **Organic Chemistry.** A continuation of the study of organic chemistry with practice in and emphasis on the application of general and special reactions to organic synthesis. Two lectures and two four-hour laboratory periods each week. F; $\frac{1}{2}$ unit. Prerequisite: One year of organic chemistry. Coviello.
349. **Pharmaceutical Assaying.** Conferences and library and laboratory experimentation related to methods for the detection and determination of impurities as well as the major components of chemicals and medicinal products. Critical evaluations and examination of general procedures are included. Topics include all forms of chromatography, electrophoresis, nonaqueous titrations, and E.D.T.A. titrations. F; $\frac{1}{2}$ unit. Prerequisite: Quantitative analysis. Kirch.
350. **Instrumental Analysis.** The principles, methods, and techniques of analytical chemistry using modern electrical and electronic instruments. Three lectures and two three-hour laboratory periods each week. Sp; 1 unit. Prerequisite: Physical chemistry, quantitative analysis, organic chemistry, and physics. Hadjiioannou.
401. **Advanced Organic Chemistry.** This course consists of systematic study of organic reactions according to their reaction types. An evaluation of the use of these reactions in the synthesis of polyfunctional compounds is discussed. Sp; $\frac{1}{2}$ unit. Prerequisite: Organic chemistry. Bauer.
402. **Advanced Organic Chemistry — Theory.** A study of the theories of organic chemical reactions and structure. Three lectures each week. Offered to classes of four or more students. W; $\frac{1}{2}$ unit. Prerequisite: One year of organic chemistry. Daniels.
403. **The Chemistry of Heterocyclic Compounds.** The nomenclature, reactions, and synthesis of heterocyclic compounds with particular emphasis on the five- and six-membered aromatic heterocyclic systems. Three lectures a week. F (usually offered in alternate years with Chemistry 409); $\frac{1}{2}$ unit. Prerequisite: One year of organic chemistry. Bauer.
404. **Advanced Inorganic Chemistry.** A systematic study of the elements based upon the periodic table and of current thought on the nature of the chemical bond. Sp (even-numbered years); 1 unit. Perkins.
405. **Introduction to Chemical Thermodynamics.** An introduction to the fundamental theory of thermodynamics with emphasis on its application to chemical problems. W; $\frac{1}{2}$ unit. Prerequisite: Physical chemistry. Joseph.
408. **Principles and Applications of Stereoisomerism.** A study of the theoretical aspects of optical isomerism, geometrical isomerism, and conformational analysis and their practical applications to stereo selective reactions. W or Sp (alternate years); $\frac{1}{2}$ unit. Prerequisite: Organic chemistry. Daniels.
409. **Vitamin Assay.** Methods for determining vitamins in pharmaceutical and food products by the use of the spectrophotometer and fluorophotometer;

microbiological methods for determining vitamins and other nutrilites. Three conferences and ten to twelve laboratory hours each week. F, W, or Sp; 1 unit. Kirch.

- 410. Molecular Spectroscopy.** An introduction to spectroscopic techniques used in determining molecular structure. The course includes an introduction to wave mechanics and concerns both the theory and application of vibrational, rotational, electronic, and nuclear magnetic resonance spectroscopy. Sp (alternate years); $\frac{3}{4}$ unit. Prerequisite: One year course in physical chemistry. Bell.
- 411. Reaction Rates and Mechanisms.** This course will include discussions of reaction velocities in homogeneous and heterogeneous systems. F (alternate years); $\frac{1}{2}$ unit. Prerequisite: One year course in physical chemistry. Perkins.
- 412. Atomic Structure and the Chemical Bond.** A discussion of the electronic structure of matter leading to the modern concept of valence and the chemical bond will be presented. The properties of molecules will be related to their structure. Sp (alternate years); $\frac{1}{2}$ unit. Prerequisite: One year course in physical chemistry. Perkins.
- 491. Seminar in Pharmaceutical Chemistry.** Weekly reviews, reports, and discussions of topics drawn from the literature of chemistry or from research. F, W, Sp; $\frac{1}{2}$ unit each quarter.
- 493. Research in Pharmaceutical Chemistry.** Individual research under the direction of a member of the staff. F, W, Sp, S; $\frac{1}{2}$ to 3 units each quarter.

Histology (Dental)

The Department of Histology offers work toward the degree of Master of Science in histology. The program is devised to provide training for teachers and investigators in the field of histology as it applies more specifically to the basic sciences related to dentistry. A student, however, is required to have a knowledge of the entire field of histology as it applies to the human body.

In addition to the general requirements of the Graduate College, the applicant must have received his Doctor of Dental Surgery degree. In certain cases an undergraduate dental student with a bachelor's degree may be accepted, providing he has maintained at least a B average and has completed at least three quarters of the dental curriculum. Nonprofessional students are not accepted.

Course requirements include Histology 401 and 402, a total of three units of non-research credit other than in seminars, and at least four units in Histology 493. Attendance at the Oral Research Seminar is required but does not carry graduate credit.

A thesis on an original investigative problem is required.

Students completing the requirements for the master's degree in histology

may apply for admission for work toward the Doctor of Philosophy degree in the Department of Anatomy and must comply with requirements of that department for the doctorate.

GRADUATE TEACHING FACULTY

Professors: ISAAC SCHOUR (Head of Department), MILTON B. ENGEL, MAURY MASSLER.

Associate Professors: ROY J. GILLETTE, NICHOLAS GRAND, VERDA E. JAMES.

Assistant Professors: JULIA MEYER, JAMES A. YAEGER.

COURSES FOR GRADUATES

- 401. Advanced Oral Histology.** Lectures, discussions, and laboratory work pertaining to special subjects and problems in oral histology. F; $\frac{3}{4}$ unit. Prerequisite: Histology 305, 328, and 329, and/or equivalent. Gillette.
- 402. Advanced Oral Histology.** Continuation of Histology 401. W; $\frac{3}{4}$ unit.
- 403. Biology of Mineralized Tissues.** Discussions and laboratory exercises concerning the formation, structure, and functions of bone, dentin, and enamel, with emphasis on mechanisms of mineralization. Sp or S (alternate years); $\frac{1}{2}$ unit. Prerequisite: Undergraduate histology. Yaeger.
- 404. Biophysical Research Methods in Histology.** Discussions and laboratory exercises on phase, interference, polarizing and electron microscopy, and microradiography. Sp or S (alternate years); $\frac{1}{2}$ unit. Prerequisite: Undergraduate histology. Yaeger.
- 493. Research in Histology.** F, W, Sp, S; $\frac{1}{2}$ to 3 units each quarter. Prerequisite: Undergraduate histology.

Medicine

The Department of Medicine offers work leading to the Master of Science degree. The program is designed to afford training for a keener approach to the theory of medicine by emphasis on basic sciences, to provide experience in research methods in the clinical field, and to develop clinical teachers who will have greater promise of rendering instruction to medical undergraduates.

A Doctor of Medicine degree is required for admission in addition to the usual requirements of the Graduate College, with the exception that currently registered medical students may be accepted if they have completed at least three quarters of the medical curriculum with a minimum average of 4.0. Such students will not be eligible for the master's degree until they have received the Doctor of Medicine degree. Clinical work carries no graduate credit.

Courses include at least one unit of formal 400 series courses and at least one seminar per quarter for three quarters in one of the basic sciences as follows: Anatomy 491, Microbiology 491, Biological Chemistry 491,

Pharmacology 491, Physiology 491, Pathology 491. Attendance at staff conferences as determined by the department is required.

The thesis must conform to standard requirements of the Graduate College and be of such merit as to warrant publication in part or in full in an acceptable scientific or clinical journal.

GRADUATE TEACHING FACULTY

Professors: HARRY F. DOWLING (Head of Department), GEORGE G. JACKSON, MAX SAMTER.

Assistant Professor: ROBERT RYAN.

COURSE FOR GRADUATES

493. Research in Medicine. F, W, Sp, S; ½ to 3 units each quarter.

Microbiology

The graduate program leading to Master of Science and Doctor of Philosophy degrees in microbiology emphasizes the medical, dental, and pharmaceutical aspects of the subject. Applicants are expected to be well oriented in fundamental biological principles and to have completed courses in general and organic chemistry, college physics, and at least one course in microbiology. While investigative work frequently follows medical interests, students are required to encompass the fundamental principles underlying an understanding of the biology of bacteria and their interrelationships to other living things. Research on pathogenic bacteria, viruses, fungi, rickettsia, and on the immunological, physiological, genetic, and biochemical principles is actively carried out under the supervision of specialists in each respective field.

The program is designed to achieve the following objectives: (1) training for future careers in academic positions at medical, dental, or pharmacy colleges; (2) training of investigators for research positions in universities, hospitals, medical schools, and biological houses; and (3) training for positions in hospital and public health diagnostic laboratories.

Applicants are considered in the order of the qualifications presented. Minimum requirements are those that apply to all applicants. Selections are made from students who have the best backgrounds as determined by a departmental committee. Selection of applicants for work for the Doctor of Philosophy degree is made from those who have obtained master's degrees.

To secure a firm foundation in microbiology, the student is required to take certain courses and is urged to attend various seminars in other departments and to do systematic reading and study.

For the Master of Science degree, Microbiology 325 and 326 are required. Two units must be earned in Microbiology 493 and two units in other formal microbiology courses in the 400 series. A student who anticipates

applying for work toward the Doctor of Philosophy degree should first complete Biological Chemistry 301 and 302. Beginning students should register for Microbiology 360 (Science Orientation).

For the Doctor of Philosophy degree, a minimum of three units of didactic formal course work is required in the 400 series courses, one unit of which must be in an area outside of the department. Included in this total are those courses already completed for the Master of Science degree. Usually well qualified students may, after the initial year of graduate work and completion of one foreign language requirement, petition to pursue a Doctor of Philosophy degree directly without completing the Master of Science requirements. A minor or substantial course work in biological chemistry is most frequently found to be appropriate. At least four units of research are required and the thesis dissertation must be of such quality as to warrant publication in abstract form. A written comprehensive examination is included as part of the preliminary examination.

All graduate students are required to include in their graduate program some time for actual participation in laboratory teaching or assisting, and advanced students are given an opportunity to present a limited number of formal lectures to undergraduate students as part of the requirements for a graduate degree. Major emphasis is on the preparation of qualified future college and university academicians.

GRADUATE TEACHING FACULTY

Professors: MILAN V. NOVAK (Head of Department), J. EMERSON KEMPF, MARK H. LEPPER, HOWARD J. SHAUGHNESSY.

Associate Professors: FRIEDRICH W. DEINHARDT, CAROLYN W. HAMMOND, ARTHUR V. KROEGER, LEON J. LE BEAU, ESTHER MEYER, ROBERT W. PUMPER, EDWARD E. VICHER.

Assistant Professors: NEWTON KHOUBYARIAN, LOUIS R. SIBAL.

Instructor: WILLIAM LANDAU.

Lecturer: GEORGE F. FORSTER.

COURSES FOR GRADUATES

325. Bacteriology and Related Microbiology. A study of the general morphology, metabolism, serology, and pathogenicity of the important microbial agents of communicable diseases; action of germicidal agents, sulfonamides, penicillin, streptomycin, and other antibiotics; factors in parasitic offense and mechanisms of host defense; detailed consideration of pathogenic bacteria. Three lectures and six hours laboratory each week. F; 1 unit. Staff.

326. Bacteriology and Related Microbiology. Continuation of Microbiology 325. Detailed consideration of viruses, pathogenic fungi, spirochaetes, rickettsia, and other microbial agents of disease; serological methods and routine hospital laboratory procedures applicable to a diagnosis of communicable

diseases. Two lectures and four hours laboratory each week. W; $\frac{2}{3}$ unit. Prerequisite: Microbiology 325 or general bacteriology. Staff.

350. **Advanced Medical Microbiology.** A course designed to further the knowledge of the student in professional medical microbiology. Recent advanced theory and practice in those aspects of medical microbiology too esoteric for inclusion in Microbiology 325 and 326. Diagnostic techniques, at research and practical levels, required by both the scholar in bacteriology and the professional whose duties include organization and supervision of the clinical bacteriology and serology laboratories. One week of practical experience in the diagnostic laboratories of Research and Educational Hospitals is included for each student. Three lectures and six laboratory hours each week. Sp; 1 unit. Prerequisite: Microbiology 325, 326, or consent of instructor. Vicher.
360. **Science Orientation.** A course designed to aid the beginning graduate student in understanding the relationship of science and the scientist to contemporary life. Seminars on the definition, history, and philosophy of science as well as a consideration of the scientist. The seminars follow a discussion guide and are moderated by students with faculty participation. Three hours lecture and discussion per week. F; $\frac{1}{2}$ unit. Kempf and others.
401. **Physiology and Metabolism of Microorganisms.** Bacterial structure as it is related to function and biochemical activity of the cell; influence of germicides, antibiotics, and other substances on the morphology and metabolism of bacteria; nature of bacterial respirations. Sp; 1 unit. Prerequisite: General bacteriology and biological chemistry. Staff.
402. **Immunology.** A lecture and laboratory course on the general nature of antigens, antibodies, and their reactions. Such immunological phenomena as the mechanisms of immunity, hypersensitivity, specificity, as well as theoretical and practical aspects of serological reactions are considered. Three lectures and six hours laboratory per week. Sp; 1 unit. Prerequisite: General and medical bacteriology or consent of instructor. Sibal.
403. **Virology.** Lectures and laboratory work on the nature of viruses, their physical, chemical, and biological characteristics; methods for propagating them in the laboratory; techniques of isolating viruses; purifying, concentrating, and observing them on the electron microscope; identification by laboratory procedures; preparation and testing of vaccines. Four hours lecture and ten hours laboratory per week. S; 1 unit. Prerequisite: General and medical bacteriology. Kempf.
404. **Medical Mycology.** Lectures, conferences, and laboratory work covering general, opportunistic, and the pathogenic fungi which cause superficial and systemic infections in man. The immunology, pathology, laboratory diagnostic procedures, chemotherapy, morphology, and biochemical reactions will be emphasized. Students are encouraged to select investigative projects. Two lectures and six hours laboratory per week. Prerequisite: General and medical bacteriology. W or Sp; 1 unit. Meyer.
405. **Microbial Genetics and Cytology.** The nature and alteration of the genetic

code, mediation of DNA control in the production of enzymes, mechanisms of information transfer, and factors affecting genetic expression. Applications to human genetics, medical, and industrial problems are indicated. Two lectures and four hours laboratory each week. W; 1 unit. Prerequisite: General microbiology, biochemistry, or consent of instructor.

- 406. Tissue Culture and Its Application to Virus Techniques.** Equipment, media, and solutions used in culture techniques for primary cell cultures as well as for established cell lines. Applications for virus isolation and diagnosis. Cytological staining, chromosome techniques, and the use of mechanical manipulations in chambers. Time lapse cinematography and other photographic techniques. Six hours laboratory and lecture per week. Sp or S; $\frac{3}{4}$ unit. Prerequisite: General or medical microbiology, or consent of instructor. Pumper.
- 407. Oncogenic Viruses.** Recent advances in the field of oncogenic viruses, with special reference to host-cell virus interrelationships, viral resistance, and latency and interference phenomena. Discussion of viruses producing leukemia, papillomata, and specific or generalized neoplastic diseases. Possible relationship of viruses to human tumors. Four hours lecture per week. Sp; $\frac{3}{4}$ unit. Prerequisite: Medical microbiology, virology, and consent of instructor. Deinhardt.
- 491. Seminar and Literature Review.** Presentation of timely subject material and individual research contributions. Each student is required to present suitable subject material. Required of all graduate students. Three hours per week. W, Sp; $\frac{1}{2}$ unit each quarter. Hammond, Kempf, Pumper.
- 493. Research in Microbiology.** Individual research including allied subjects usually included under this title such as virology, immunology, mycology, and metabolism and tissue culture. F, W, Sp, S; $\frac{1}{2}$ to 3 units each quarter. Staff.

Oral Pathology

The Department of Oral Pathology offers work toward the degree of Master of Science. The program is devised to provide training for teachers and investigators in the field of oral pathology. A student, however, is required to have a knowledge of the entire field of pathology.

In addition to the general requirements of the Graduate College, the applicant must have received his Doctor of Dental Surgery degree. Non-professional students are not accepted.

Courses required of all candidates for the Master of Science degree include Pathology 325 (four and one-half units) or its equivalent, at least four units of Oral Pathology 493, and one-half unit of Oral Pathology 491. Additional courses and seminars are to be determined by the major adviser on an individual basis and should be in the field of basic sciences. A thesis on an original investigative problem is required.

Students completing the requirements for the master's degree in oral

pathology may apply for admission for work toward the Doctor of Philosophy degree in the Department of Pathology, and must comply with requirements of that department for the doctorate.

GRADUATE TEACHING FACULTY

Associate Professors: NICHOLAS G. GRAND, HERMAN MEDAK.

Assistant Professor: JULIA MEYER.

Research Associate: SHU YUNG WANG.

COURSES FOR GRADUATES

310. Advanced Oral Pathology. The course offers an analysis of disease processes of special interest to theoretical and applied stomatology. Lectures, demonstrations, discussions. F, W, Sp; ½ unit each quarter. Prerequisite: Physiology 302, Microbiology 325, General Pathology 351, Oral Pathology 353, or consent of instructors. Grand, Wang.

491. Seminar in Oral Pathology. Weekly reviews, reports, and discussion of topics drawn from the literature and the material of surgical oral pathology. F, W, Sp; ½ unit each quarter. Grand.

493. Research in Oral Pathology. F, W, Sp, S; ½ to 3 units each quarter. Staff.

Oral Surgery

A degree of Master of Science is offered in oral surgery. The program is designed to provide training in research and teaching as well as a comprehensive basic science background. Prerequisites for admission are a Doctor of Dental Surgery degree from an accredited institution, with a minimum combined grade-point average of 3.5 in both preprofessional and professional work.

At least four units of Oral Surgery 493 are required for the Master of Science degree. In addition, three units of non-research courses exclusive of seminars are determined by the major adviser and may include Pathology 325, Anatomy 301, Oral Pathology 491, Histology 401, Pharmacology 325, Physiology 301, and others suited to the individual needs of the student. A thesis on an original investigative problem is also required.

A minimum of two years is necessary for completion of the program. During this period the student is required to devote a portion of his time to teaching and assisting in the department. Students in the three-year combined didactic and clinical training program are registered on a full-time basis in the Graduate College for the first academic year, after which part-time registration is maintained during the internship and residency periods. Graduate credit, however, is not granted for clinical work.

GRADUATE TEACHING FACULTY

Professors: AXEL G. ANDERSON (Head of Department), DANIEL M. LASKIN.

COURSE FOR GRADUATES

493. Research in Oral and Maxillofacial Surgery. F, W, Sp, S; ½ to 3 units each quarter.

Orthodontics

The degree of Master of Science is offered in orthodontics. The program is primarily one of training for research and teaching in the basic and applied sciences in orthodontics.

All applicants must have the degree of Doctor of Dental Surgery from an accredited dental college, must meet the 3.5 minimum combined grade-point requirement of the Graduate College for undergraduate preprofessional and professional college courses, and must be approved by the departmental staff.

A minimum residence of eighteen consecutive months or two academic years is required. During the first nine months all students are classified in the postgraduate division. Those showing scholarly proficiency and research ability are admitted for the next nine months or more as candidates for the Master of Science degree in the Graduate College. They must write an acceptable thesis on an original investigation and pass an oral examination. Students not accepted for the degree program but who successfully complete eighteen months' work without a thesis receive a certificate of proficiency in orthodontics. This professional program is not administered by the Graduate College.

Required courses for the Master of Science degree include Orthodontics 401 and at least four units in Orthodontics 493. Three units of non-research courses exclusive of seminars are required, not more than one unit of which may be absolved by Orthodontics 401. Other units toward this requirement may be met by taking graduate courses in anatomy, Histology 401 and 402, or other courses in the basic sciences. Additional courses may be required by the major adviser. Students must register for a full program of three units each quarter or spend additional time to complete requirements.

GRADUATE TEACHING FACULTY

Professors: ALLAN G. BRODIE (Head of Department), MILTON B. ENGEL.

Associate Professor: SAMUEL PRUZANSKY.

COURSES FOR GRADUATES

401. Orthodontics. An intensive course covering three quarters and including the study of the phylogeny of teeth, jaws, and head, comparative anatomy and physiology of the dental apparatus, applied functional anatomy and physiology of the human masticatory mechanism, growth and development of the head skeleton and of the human dentition, both normal and abnormal, and the etiology of malocclusion and research methods pertaining to the field. F, W, Sp, S; 1 unit each quarter. Brodie.

493. Research in Orthodontics. Special research in fields appropriate to the major subject. F, W, Sp, S; ½ to 3 units each quarter.

Orthopaedic Surgery

A graduate program leading to a degree is not offered in this area. Students registering for graduate work in the basic sciences and other disciplines may take advantage of the offerings in this department.

GRADUATE TEACHING FACULTY

Professors: ROBERT D. RAY (Head of Department), CLAUDE N. LAMBERT.

Assistant Professor: JOSEPH E. MILLER.

Research Associate: TAWFIK Y. SABET.

COURSES FOR GRADUATES

421. Special Techniques in Bone and Cartilage Research. (Histological and Histochemical Methods.) F; ½ unit.

422. Special Techniques in Bone and Cartilage Research. (Tissue Culture and Transparent Chamber Techniques.) W; ½ unit.

423. Special Techniques in Bone and Cartilage Research. (Radioisotope Methods.) Sp; ½ unit.

491. Seminar in Orthopaedics. Weekly reviews, reports, and discussions of current subjects and individual research contributions. W, F, Sp; ½ unit.

Pathology

The Department of Pathology offers graduate work leading to the degrees of Master of Science and Doctor of Philosophy. The peculiar and unique position of pathology as a bridge between the preclinical and clinical disciplines is well recognized. Students who seek to become competent for the practice of anatomic or clinical pathology, or both, in general take post-graduate residency training. However, graduate work is encouraged and can be fitted into the framework of a residency training program. In particular, those planning an academic career of research and teaching in pathology will profit by a sequence leading to an advanced degree in pathology. Students majoring in other biological sciences may advantageously choose certain of the courses offered in the Department of Pathology as part of a minor field. Graduate work in pathology includes the advanced study of diseases from the standpoint of the pathogenesis of their structural and functional expressions. It utilizes in part, therefore, a unique methodology and, in part, the techniques of all other preclinical and clinical disciplines.

To qualify for admission to graduate study in pathology, the applicant must be an outstanding student who can meet the general admission requirements and has completed the basic science courses including general and special pathology in a Class A medical or dental school. This will in general

include the following courses or their equivalent: Anatomy 301 and 302; Biological Chemistry 301 and 302; Physiology 301, 302, and 303; Pathology 325. Students not seeking the Doctor of Medicine or Doctor of Dental Surgery degrees may be admitted, provided they have completed courses in microscopic and gross anatomy, biochemistry, and physiology, and in addition Pathology 325 or its equivalent. In the absence of preliminary course work which can be adequately evaluated, the department may require a written examination. Students may elect pathology as a minor if they have completed medical or dental courses in essentially the above subjects including Pathology 325.

A limited number of stipends are available to qualified candidates.

Required courses for the Master of Science degree are: Pathology 491; at least two units in Pathology 493; and at least one unit in Pathology 401, 402, 403, 404, or 405. Additional non-research courses to fulfill the minimum formal requirements set by the Graduate School are selected by the student with the advice of the major adviser. Highly recommended courses are: Microbiology 360 and 402, Public Health 401, and Radiology 401. Attendance is required at certain staff and pathology conferences and at seminars.

The Master of Science degree in pathology is regarded as an adequate and significant terminal degree for those whose ultimate objectives will embrace practice, teaching, and research in pathology. The Ph.D. degree will interest those looking to careers in research and teaching more specifically. Courses completed in the M.S. program count toward the total unit requirement for the Ph.D. degree, for which the minimal formal requirements are set forth in the general instructions. Required courses are Pathology 491, 493, and a selection from Pathology 401, 402, 403, 404, and 405. Highly recommended courses are: Microbiology 402 and 403; Public Health 401 and 403; Radiology 401, 402, 403, and 410; Anatomy 433; Biological Chemistry 410; and Physiology 401, 407, and 486. Within this general framework it is expected that the program would be geared to the attainments and requirements of each individual candidate.

Requirements for the minor in pathology are: Pathology 491; one or more units in Pathology 401 through 405; and the balance of not more than two units in Pathology 493.

Theses for both M.S. and Ph.D. degrees are ordinarily based on the problem selected for investigation. Great latitude is allowed in this selection, and studies concerning any of the biological phenomena operating in health and disease are considered suitable provided the work is of adequate scope, dimension, and importance. The customary standards governing candidates for these degrees are required. Theses based on work other than experimental are not accepted.

GRADUATE TEACHING FACULTY

Professors: CECIL A. KRAKOWER (Head of Department), ORVILLE T. BAILEY, GRANVILLE A. BENNETT, JOHN B. FULLER, GEORGE M. HASS, DANIEL M. LASKIN, ELIZABETH A. MCGREW, CONRAD L. PIRANI, KURT STERN.

Research Professor: HUBERT R. CATCHPOLE.

Associate Professors: ELIE P. LEROY, MARTIN A. SWERDLOW.

Assistant Professor: JULIA MEYER.

COURSES FOR GRADUATES

- 325. General and Special Pathology Including Clinical Pathology.** The basic principles of pathological processes, including tissue injury and repair, inflammation, circulatory disturbances, retrograde processes, and tissue responses to specific infectious agents and neoplasms, are considered in the first part of the course. In the latter part of the course, the disease processes affecting each organ and anatomic system are considered in greater detail. The laboratory exercises are designed to correlate and interpret the gross, microscopic, and functional changes occurring in diseased tissues. Lectures, demonstrations, sectional conferences, and laboratory. Thirteen hours each week. F, W, Sp; 4½ units (1½ units each quarter). Prerequisite: Anatomy, histology, biological chemistry; at least introductory work in microbiology and physiology. Staff.
- 401. Experimental Pathology.** Lecture, seminar, and laboratory course in the essentials of experimental pathology. Limited to six qualified students. F; 1 unit. Prerequisite: Undergraduate courses in pathology and anatomy, including histology. Catchpole.
- 402. Histochemistry.** Lecture and laboratory course in methods and results of investigation in histochemistry. Fields covered depend on interests of students and may include work with inorganic substances, carbohydrates, vitamins, hormones, nucleic acids, enzymes, and amino acids. Limited to six students. Sp; 1 unit. Prerequisite: Biological chemistry and histology. Catchpole.
- 403. Physiological Basis of Pathology.** Lecture, seminar, and laboratory in physiological mechanisms underlying abnormal structure and function. Limited to six qualified students to be selected after an interview. W; 1 unit. Prerequisite: General pathology, physiology, biological chemistry, and anatomy. Catchpole.
- 404. Pathologic Ultrastructure.** Sp; ¼ unit. Prerequisite: Anatomy, histology, and pathology. Krakower, Hass, and Staff.
- 405. Experimental Oncology.** Lecture and laboratory course in problems of experimental tumorigenesis. W, Sp; ½ unit. Prerequisite: General pathology and histology. Stern.
- 491. Pathology Seminar.** Weekly seminar covering selected fields of interest and research in pathology. F, W; ½ unit each quarter. Staff.
- 493. Research in Pathology.** F, W, Sp, S; ½ to 3 units each quarter. Staff.

Pedodontics

The degree of Master of Science is offered to students in pedodontics who wish to prepare themselves for an academic career of teaching and research. Applicants must have the degree of Doctor of Dental Surgery or Doctor of Dental Medicine from an accredited dental college, and must satisfy the preprofessional and professional requirements of the Graduate College. A minimum combined grade-point average of 3.5 is required by the Graduate College. The candidate must also have completed three quarters (nine months full time) of the postgraduate curriculum in pedodontics.

The curriculum is varied and arranged to best suit the academic objectives of the candidate. The candidate must complete a minimum of nine units, at least two of which must be in non-research basic science courses, one in Pedodontics 491, and four in Pedodontics 493 (Research).

A thesis based on an original research problem is required.

GRADUATE TEACHING FACULTY

Professor: MAURY MASSLER (Head of Department).

COURSES FOR GRADUATES

491. Seminar in Pedodontics. An intensive seminar course including problems in physical growth, emotional growth, diet and nutrition, endocrinology, pediatric problems in health and disease, and preventive dentistry. Research methods and an introduction to experiment design and statistics are presented during the spring quarter. F, W, Sp, S; ½ to 1 unit each quarter.

493. Research in Pedodontics. F, W, Sp, S; ½ to 3 units each quarter.

Pharmacognosy

Programs leading to the degrees of Master of Science and Doctor of Philosophy are offered in pharmacognosy and are subject to the general regulations of the Graduate College.

Prerequisites for admission, in addition to the general requirements of the Graduate College, include a degree of Bachelor of Science in pharmacy from an accredited institution. Reading proficiency in either French or German is required for all M.S. candidates. Both languages are required for Ph.D. candidates. However, one of these may be substituted by petition.

The student must show evidence of undergraduate training adequate to the program projected in the Graduate College. Additional undergraduate courses may be required, without graduate credit, to fulfill the necessary background. Such courses must be completed before or during the first year of graduate study.

Facilities for teaching and research in this department are offered to qualified students in three principal categories: (1) those majoring in pharmacognosy; (2) those majoring in other fields, electing minor study in

pharmacognosy; and (3) graduate students seeking courses in this department as adjuncts to their major and minor programs in other fields.

Teaching assistantships in pharmacognosy are available to qualified students. Candidates for the Ph.D. degree are required to participate in undergraduate teaching.

A proficiency examination which covers the fundamental principles of the botanical sciences is required of all applicants to evaluate their respective needs.

The following courses are required of all students seeking advanced degrees in pharmacognosy: Pharmacognosy 301, 302, and 491. Candidates for the degree of Master of Science must have completed not less than one unit and candidates for the Doctor of Philosophy not less than two units from the following group: Pharmacognosy 401, 405, and 491.

Additional courses needed to complete the major program in pharmacognosy may be elected from the above courses and/or from the following: Pharmacognosy 303, 304, 306, 310, and 316.

Supporting programs including such courses or minors may be chosen from the following: Biological Chemistry 301, 302; Chemistry (Pharmaceutical) 303, 304, 409, 410; Pharmacology 325, 326, 491, 493; Microbiology 401, 402, 403, 404. All courses are elected with the approval of the major adviser.

GRADUATE TEACHING FACULTY

Professor: RALPH F. VOIGT (Head of Department).

Associate Professors: CONRAD BLOMQUIST, BERNARD GREENBERG.

Assistant Professors: EDWARD S. MIKA, ALLAN M. BURKMAN, FRANK A. CRANE, RALPH W. MORRIS.

COURSES FOR GRADUATES

301. **Plant Anatomy.** A microscopic study of the structure of vascular plants, with particular attention to the development of the vascular systems in all parts of the plant. Two lectures and two three-hour laboratory periods each week. W; 1 unit. Crane.
302. **Plant Physiology.** A study of life processes in plants, with particular attention to the cell as the fundamental functional unit. The basic principles of plant metabolism are emphasized in relation to essential elements, energy relationships, and other environmental factors. Three lectures and one three-hour laboratory period each week. F; 1 unit. Prerequisite: Pharmacognosy 301. Mika.
303. **Systematic Pharmacognosy.** A taxonomic study of the flowering plants, with particular emphasis upon those of drug importance. Relationship of the principal orders and families, rules of nomenclature, and systems of classification are considered. Laboratory work includes identification of species, together with the collection, identification, and preservation of drug plant

specimens. Two lectures and three three-hour laboratory periods each week. Sp (alternate years); 1 unit. Voigt.

- 304. Genetics.** A consideration of the fundamental principles of biological inheritance, and the application of these in the study of the plant and animal life. Three lectures and two three-hour laboratory periods each week. F or W; 1 unit. De la Torre.
- 306. Pharmacognosy of the Allergens.** An atmospheric survey and study of the wind-borne pollen and fungi spores; the identification and distribution of hay fever plants and the practical application of these studies. Two lectures and one three-hour laboratory period each week. Sp, S; $\frac{1}{2}$ to 1 unit. Voigt.
- 310. Bioassay.** Official, industrial, and general bioassay procedures are studied with emphasis on their applicability. Their reliability is considered on a statistical basis. Laboratory demonstration periods will emphasize the designing, setting-up, and analysis of representative bioassay preparations. Two lectures and two three-hour laboratory demonstration periods each week. W (alternate years); $\frac{3}{4}$ unit. Burkman and Morris.
- 314. Histological Techniques.** A theoretical and practical development of the knowledge and skills essential to the preparation of biological materials for microscopic study. One lecture and two three-hour laboratory periods each week. F or W; $\frac{1}{2}$ unit. Blomquist.
- 316. Commercial Pharmacognosy.** A study of the traffic in crude drugs and related products, with consideration of the basic principles governing the production, distribution, and consumption of these materials. Three lectures or conferences each week. F; $\frac{1}{2}$ unit. Voigt.
- 401. Drug Plant Cultivation.** A consideration of the principles involved in the propagation and care of drug plants, combined with practical applications at the Drug Plant Experiment Station. Attention is given to the principles and practices of harvesting, preparation, storage, and marketing. Two lectures and three three-hour laboratory periods each week. Sp or S; 1 unit. Prerequisite: Pharmacognosy 302. Voigt.
- 405. Quantitative Pharmacognosy.** The use of quantitative methods and a study of their application in the microscopic and macroscopic evaluation of drugs, including the development of new methods. One lecture and two three-hour laboratory periods each week. W (alternate years); $\frac{1}{2}$ unit. Prerequisite: Pharmacognosy 301. Voigt.
- 491. Seminar in Pharmacognosy.** F, W, or Sp; $\frac{1}{2}$ unit each quarter.
- 493. Research in Pharmacognosy.** F, W, Sp, S; $\frac{1}{2}$ to 3 units each quarter.

Pharmacology

Pharmacology is one of the basic medical sciences in which graduate study is available only at the Medical Center. Pharmacology is the science which deals with the qualitative and quantitative aspects of the effects of

drugs and other chemical compounds upon the living organism. The program of graduate study takes cognizance of the breadth of pharmacology. Specialization is possible in each of the major subdivisions of modern pharmacology, including pharmacodynamics, neuropharmacology, chemotherapy, toxicology, and therapeutics. Pharmacodynamics is the study of physiological and biochemical events resulting from the action of drugs on cells and organisms. Chemotherapy is the study of the selective toxicity of drugs for microorganisms, parasites, and neoplastic diseases. Toxicology is the study of noxious actions of chemical compounds. Therapeutics is the study of the effects of drugs in combating disease.

Pharmacology is intimately interwoven with other medical sciences. A clear understanding of biochemistry and physiology is necessary for the interpretation of drug action. Rational therapeutics depends upon knowledge of pathogenesis and pathology. There is similarly close connection between pharmacology and bacteriology, biophysics, anatomy, and other fundamental medical disciplines. Accordingly, the programs in pharmacology leading to the degrees of Master of Science and Doctor of Philosophy require broad training in advanced fields of pharmacology as well as a basic background in other medical sciences.

The curriculum is designed to train candidates for teaching in medical schools and for research in universities, industry, and governmental laboratories. Preference is given to applicants who have completed a major in biological sciences or chemistry in undergraduate courses, and who show evidence of a sincere desire for a teaching and research career in the medical sciences.

Candidates for the degree of Master of Science are required to complete Pharmacology 325, 326, or their equivalent, at least four units in Pharmacology 493, and three units in non-research courses listed in this catalog.

Candidates for the degree of Doctor of Philosophy are required to complete Pharmacology 325, 326, or their equivalent, and to earn a minimum of nine units in Pharmacology 493 and three units in non-research courses in the 400 series. The selection of courses is made at the time of an interview by a qualifying committee and the student's proposed adviser. A suitable course or a proven working knowledge of biometrics is required of all candidates for a doctor's degree. The thesis for the doctorate should be of such merit as to warrant publication in part or in full in a recognized scientific journal. Participation in teaching in laboratories, conferences, and seminars is part of the curriculum of all degree candidates.

Pre- and postdoctoral traineeships in pharmacology and neuropharmacology, including tuition, dependency allowances, and travel to scientific meetings are available to qualified students.

GRADUATE TEACHING FACULTY

Professors: KLAUS R. UNNA (Head of Department), WALTER J. R. CAMP, THEODORE R. SHERROD.

Associate Professors: ADRIAN OSTFELD, MARTIN P. SCHULMAN, CEDRIC M. SMITH.

Assistant Professor: ALLEN W. GOMOLL.

COURSES FOR GRADUATES

- 325. Pharmacology, Toxicology, and Chemotherapy.** Principles of therapy, toxicology of heavy metals and industrial solvents; chemotherapy of neoplasms; drugs affecting hematopoiesis; chemotherapy of infectious diseases; autonomic drugs; cardiac drugs; diuretics; anesthetics, general and local; adjuncts to anesthesia; sedatives, hypnotics, and analgesics; drug addiction. Lectures, correlation exercises, and laboratory, seven hours each week. W; 1 unit. Staff.
- 326. Pharmacology, Toxicology, and Chemotherapy.** Drugs affecting the central nervous system; toxicology of the central nervous system depressants; anti-allergic drugs; inhalation therapy; vitamins and nutritional factors; endocrine glands. Lectures, conferences, correlation exercises, demonstration, and laboratory, five hours each week. Sp; $\frac{2}{3}$ unit. Staff.
- 401. Principles of Pharmacological Methodology.** This course presents discussions of the principles and logic of the scientific method as employed in pharmacological research and a series of demonstrations and discussions of specific pharmacological methods emphasizing their use in studies of drug action, their reliability, variability, and validity as scientific methods. Lectures and demonstrations. Quarter to be announced; $\frac{1}{2}$ unit. Prerequisite: Pharmacology 325 and 326, or equivalent. Staff.
- 402. Biochemical Mechanisms of Drug Action.** Discussions of the kinetics of enzyme action and the role of drugs as inhibitors and activators of components of multi-enzyme systems as well as of specific enzymes. Advances in chemotherapy of neoplasia, antibiotics, and chemical mediators are in terms of analogue inhibitors and enzyme-substrate interactions. Vitamins and hormones are discussed as cofactors for reactions and control mechanisms for reaction sequences. Lectures. Quarter to be announced (alternate years); $\frac{1}{2}$ unit. Prerequisite: Pharmacology 325 and 326, or equivalent. Schulman.
- 403. Pharmacology of Drugs Altering Skeletal Muscle Function.** Discussions of the anatomy and physiology of skeletal muscle and the nature of the alterations in the function of the neuromuscular system produced by drugs, including natural and synthetic curarizing agents, and curare antagonists. Specific topics include structure-activity relationships on curariform compounds, effects of these drugs in man and their use in anesthesia, and methods used in the investigation of neuromuscular function. Lectures and demonstrations. Quarter to be announced (alternate years); $\frac{1}{2}$ unit. Prerequisite: Pharmacology 325 and 326, or equivalent. Smith.
- 404. Neuropharmacology.** Discussions of drug action at various levels of the

central nervous system. Topics include the physiology and pathophysiology of the nerve cell membrane, the extra pyramidal system, the reticular activating system, the higher inflows to the autonomic nervous system and the cerebral cortex in relation to drug actions which influence epileptic seizure activity, motor dyskinesias, consciousness, psychosomatic disorders, and psychoneurotic behavior. Lectures and demonstrations. Quarter to be announced (alternate years); ½ unit. Prerequisite: Pharmacology 325 and 326, or equivalent. Staff.

405. Advanced Topics in Cardiovascular and Renal Pharmacology. Drug action on the cardiovascular system and kidneys, with special emphasis on the failing heart, cardiac arrhythmias, electrolytes and the heart, and renal hemodynamics as influenced by drugs. Lectures. Quarter to be announced (alternate years); ½ unit. Prerequisite: Pharmacology 325 and 326, or equivalent. Sherrod.

406. Rational Application of New Therapeutic Agents. Presentation of pharmacological and toxicological considerations of recently developed drugs and their rational use in therapeutics. Lectures. Quarter to be announced (alternate years); ½ unit. Prerequisite: Pharmacology 325 and 326, or equivalent. Staff.

407. Forensic Toxicology. The role played by toxicology in forensic sciences, with particular emphasis on its relation to legal medicine. Lectures. Quarter to be announced (alternate years); ½ unit. Prerequisite: Pharmacology 325 and 326, or equivalent. Camp.

408. Metabolism of Drugs. The metabolic fate of a variety of drugs will be presented in lectures, demonstrations, and laboratory exercises. The fate of drugs will be discussed in terms of general metabolic reactions including hydrolytic cleavage, oxidations, specific reductions, conjugations, and lethal syntheses. The special role of microsomes in drugs metabolism will be emphasized. Structure-activity relationships will be considered in the light of metabolism of series of drugs. Lectures and demonstrations. Quarter to be announced (alternate years); ½ unit. Prerequisite: Pharmacology 325 and 326. Schulman.

409. Chemical Structure and Biological Activity. (1) Analysis of pharmacological action of drugs as related to their molecular structure and steric configuration; (2) structure of drugs; methods for defining and measuring drug action; nature of drug receptors; theoretical drug design; structure activity relationships will be exemplified by autonomic drugs; drugs acting on the neuromuscular synapses of the striated muscles; histamine and antihistamines; local anesthetics; synthetic analgesics; steroid hormones; vitamins; sulfonamides. Lectures and demonstrations. Quarter to be announced (alternate years); ½ unit. Prerequisite: Pharmacology 325 and 326. Unna and Staff.

491. Pharmacological Seminar. F, W, Sp; ½ unit each quarter. Staff.

493. Research in Pharmacology. Supervised research in pharmacodynamics, neuro-

pharmacology, toxicology, chemotherapy, and cellular pharmacology. F, W, Sp, S; ½ to 3 units each quarter. Staff.

Pharmacy

The Department of Pharmacy offers graduate programs leading to the degrees of Master of Science and Doctor of Philosophy. These programs are designed so that the candidate will receive an adequate background in the basic physical and biological sciences as well as the pharmaceutical sciences and the related health disciplines. Sufficient flexibility is permitted so that the candidate can develop himself in breadth and depth in selected areas of specialization. Graduate study in pharmacy prepares qualified individuals for teaching, industry, and research in the field of pharmacy.

Admission to graduate study in pharmacy is subject to the general regulations of the Graduate College. The applicant should have received a Bachelor of Science, Bachelor of Science in pharmacy, or Bachelor of Pharmacy degree from a college of pharmacy approved by the Graduate College of the University of Illinois. Applicants holding a Bachelor of Science or Bachelor of Arts degree from a college other than a college of pharmacy may be accepted if they are currently completing the requirements for a Bachelor of Science in the undergraduate curriculum in pharmacy. The undergraduate preparation should include, among others, the following preparation: general and inorganic chemistry and qualitative analysis, eight semester hours; mathematics, including an introduction to the calculus, seven semester hours; organic chemistry, eight semester hours; physics, eight semester hours; biological chemistry, three semester hours; pharmacy, twenty semester hours; pharmacology, eight semester hours; quantitative analysis, including drug assaying, seven semester hours. An elementary course in physical chemistry is advisable.

Students enrolled for their first year of graduate study may be examined on their knowledge of the fundamental principles of the physical sciences and pharmaceutical technology, and their ability to correlate these studies. The results of these examinations are the basis for recommendation to the final examination for the master's degree.

Of the minimum nine units required for the Master of Science degree with a major in pharmacy, at least four units including Seminar must be completed in course work acceptable for graduate credit, and at least four units must be completed in work leading to the production of an acceptable thesis (Pharmacy 493). If, in the judgment of the major adviser, the undergraduate background requires strengthening, the applicant may be required to complete more than the minimal number of units in course work before a thesis subject is completed.

Students pursuing the degree of Doctor of Philosophy with a major in

pharmacy are required to complete successfully the following sequence of courses in pharmacy, chemistry, and public health: Pharmacy 305, 410, 411, 440-443 (1 unit), and 310 or 402; Chemistry (Pharmaceutical) 335, 336, and 350; and Public Health 401. These constitute the core or required courses, and total six units. All students are required to take Pharmacy 491, Seminar, for a total of two units. Attendance is required in Seminar each quarter whether or not it is taken for credit. Minor or elective courses, up to four units, may be selected from the graduate course offerings in the departments of Chemistry (Pharmaceutical), Biochemistry, Microbiology, Pharmacognosy, Pharmacology, and Public Health.

A minimum of fifteen units including those earned toward the Master of Science degree must be devoted to Pharmacy 493, and must culminate in the production of an acceptable dissertation. The research project must be an original investigation and should deal with some basic science aspect of general pharmacy, physical pharmacy, manufacturing pharmacy, or a closely related problem of pharmaceutical interest.

All graduate study programs in pharmacy are under the general supervision of the Head of the Department of Pharmacy. The candidate must select as his major adviser a member of the graduate faculty. This should ordinarily be done before the start of the second quarter in which the student is enrolled. The major adviser has immediate supervision of the candidate's program of study, subject to approval by the Head of the Department.

A departmental examination, partly written and partly oral, is required of all doctoral candidates majoring in pharmacy. The examination is designed to demonstrate the student's knowledge of scientific principles and their application to pharmacy. On the basis of the results of this examination, the major adviser may recommend the student for examination by the preliminary doctoral committee, or may recommend further preparatory study.

GRADUATE TEACHING FACULTY

Professors: MARTIN I. BLAKE (Head of Department), DWIGHT L. DEARDORFF.

Assistant Professors: HERBERT S. CARLIN, BERNARD EKANOW, FREDERICK P. SIEGEL.

COURSES FOR GRADUATES

300. Hospital Pharmacy. Study and practice of the administrative and operational aspects of hospital pharmacies. Three lectures and two four-hour laboratory sessions each week. F; 1 unit. Carlin.

305. Physical Pharmacy. The problems encountered in the fabrication and preservation of dosage forms of medication are studied from the standpoint of the physico-chemical principles and laws which may lead to their

solution. Chemical kinetics and catalysis are areas which are especially important. F; ½ unit. Prerequisite: Pharmacy 123. Ecanow.

- 310. Pharmaceutical Manufacturing Unit Operations.** The study of the scientific principles in unit operations of pharmaceutical manufacturing. Two lectures and one four-hour laboratory per week. W; ½ unit. Prerequisite: Pharmacy 305, or departmental permission. Ecanow.
- 402. Manufacturing Pharmacy.** Lectures, library, and laboratory work on the processes used in the preparation and evaluation of solid, semisolid, and fluid pharmaceutical products. Studies of the physical, chemical, and biological interrelationships between ingredients, procedure, equipment, containers, and storage conditions. Lectures and library work may be elected without laboratory, but students electing laboratory work must elect the lectures either simultaneously or as a prerequisite. F, W, Sp; ½ to 1 unit each quarter for a total of not more than three units. Prerequisite: Departmental permission. Deardorff.
- 410. Polyphasic and Disperse Systems, I.** A study of reversible and irreversible colloidal systems. Three lectures each week. W; ½ unit. Prerequisite: One year of physical chemistry or the equivalent. Deardorff, Ecanow.
- 411. Polyphasic and Disperse Systems, II.** Further study of colloidal electrolytes, and the liquid-gas, solid-gas, and liquid-liquid systems. Three lectures each week. Sp; ½ unit. Prerequisite: One year of physical chemistry or the equivalent. Deardorff, Ecanow.
- 440, 441, 442, 443. Special Topics in Pharmacy.** A consideration of selected topics in pharmacy. Several specialized topics of pharmaceutical importance are presented. The specific topics may vary each time the course is offered. The topics to be considered include: rheology, micromeretics, physics of tablet compression, biopharmacy, adjusted solutions, drug extraction techniques, sustained release medication, aerosols, formulation, etc. F, W, Sp, S; ½ unit each quarter for not more than three quarters. Prerequisite: Departmental permission. Staff.
- 491. Seminar in Pharmacy.** Weekly reviews, reports, and discussions of topics drawn from the literature of pharmacy or from research. F, W, Sp; ½ unit each quarter for not more than two quarters. Staff.
- 493. Research in Pharmacy.** Individual research under the direction of a member of the staff. F, W, Sp, S; ½ to 3 units each quarter. Staff.

Physiology

The graduate program in physiology is designed to prepare students for careers in teaching and research, with emphasis on both systemic and cellular physiology. The department accepts candidates for both Master of Science and Doctor of Philosophy degrees although preference is given to the latter.

A broad spectrum of formal, seminar, and technical courses is offered, providing students with solid grounding in fundamentals as well as unusual

opportunities for specialization. Course programs are chosen to meet best the individual requirements of students; they are developed jointly by the student and his adviser with the approval of the graduate committee of the department. Normally, the candidate for the Ph.D. degree with only a bachelor's degree requires four years to complete his training; with professional degrees such as an M.D., about three years.

Doctoral candidates are encouraged to be prepared with undergraduate course work in chemistry, through organic and preferably including physical chemistry; in mathematics, through calculus; and with at least one year of biology and physics.

Normally, the Ph.D. candidate takes his comprehensive preliminary examination at the completion of his formal course work, usually at the beginning of the third year of a four-year program. This examination has two parts: a written, which must be passed first, and an oral. Students who have completed all requirements for the doctoral degree, including an accepted thesis, are expected to expound their work at a special seminar, a ceremony representing their first public offering as scholars.

GRADUATE TEACHING FACULTY

Professors: ARNOLD V. WOLF (Head of Department), HAROLD E. HIMWICH, RAYMOND C. INGRAHAM, JOHN P. MARBARGER, WILLIAM V. WHITEHORN.

Associate Professors: NORMAN R. ALPERT, ARTHUR J. DERBYSHIRE, RUVEN GREENBERG, AKIRA OMACHI, NEENA B. SCHWARTZ, STEPHEN L. SHERWOOD.

Assistant Professors: SABATH MAROTTA, H. LAWRENCE MCCROREY, J. LANGDON TAYLOR, JR., HENRY TEDESCHI.

COURSES FOR GRADUATES

301. **Human Physiology.** A comprehensive survey of mammalian physiology with special reference to man. F; 1 unit. This course or equivalent required for all graduate students. Staff.

302. **Human Physiology.** Continuation of Physiology 301. W; 1 unit. Staff.

303. **Human Physiology.** Continuation of Physiology 302. Sp; 1 unit. Staff.

401. **Physiology of the Endocrines.** Advanced study of the concepts of control of endocrine secretion; the mechanism of action of the hormones and other special problems in the field of endocrinology. One three-hour lecture-conference per week. W (alternate years); $\frac{3}{4}$ unit. Prerequisite: Physiology 301, 302, and 303 or equivalent. Schwartz.

404. **Brain Physiology.** A series of seminars concerned with recent advances in the field of brain physiology and biochemistry, especially in regard to application to clinical problems. Summaries of papers are presented by the students and discussed. F (alternate years); $\frac{1}{2}$ unit. Prerequisite: Physiology 301, 302, and 303 or equivalent. Himwich.

405. **Physiology of the Heart.** Advanced study of basic metabolic and functional

determinants of cardiac activity. Discussion of modern views and newer clinical and experimental techniques in cardiology. One two-hour lecture-conference per week. Sp (alternate years); $\frac{1}{2}$ unit. Prerequisite: Physiology 301, 302, and 303; Biochemistry 301 and 302. Whitehorn.

- 406. Physiology of the Gastrointestinal Tract.** An advanced course dealing with selected topics in gastrointestinal physiology. The particular subjects vary from year to year. One or two topics are considered each time the course is given. Topics include secretion, motility, and absorption. Detailed topic outline to be announced. Lectures, seminars, and intensive laboratory. One four-hour period per week. Sp (alternate years); $\frac{1}{2}$ unit. Prerequisite: Physiology 301, 302, and 303 or equivalent. Ingraham.
- 408. Metabolism and Function of the Central Nervous System.** An advanced course correlating the metabolism and function of the whole brain and its cellular and subcellular components during development and in the mature organism. Lectures and seminars. One two-hour period per week. W (alternate years); $\frac{1}{2}$ unit. Prerequisite: Physiology 301, 302, and 303; Biological Chemistry 301 and 302 or equivalent. Staff.
- 411. Mathematical Biophysics.** Theoretical treatment of transport phenomena in selected metabolic systems. Detailed topic outline to be announced. Two one-hour lecture-conference meetings per week. Quarter to be announced (alternate years); $\frac{1}{2}$ unit. Prerequisite: Credit or registration in Physiology 301, 302, and 303 or equivalent, knowledge of differential and integral calculus, and physical chemistry. Staff.
- 412. Analog Computer Technics.** A laboratory course designed to acquaint the student with practical analog computer technics in physiology. Each student is required to set up and solve assigned problems on the departmental computer. Registration limited. One three-hour period per week. Quarter to be announced (alternate years); $\frac{1}{2}$ unit. Prerequisite: Physiology 301, 302, 303, and differential and integral calculus, or equivalents.
- 471. Methods in Experimental Physiology.** A laboratory course designed to acquaint students with standard procedures, techniques, and measurements in physiologic investigations. F (alternate years); $\frac{1}{2}$ unit. Prerequisite: Credit or registration in Physiology 301, 302, or 303. McCrorey and Staff.
- 482. Neurophysiology and Behavior.** This course is designed to meet the needs of students desiring advanced, detailed knowledge of a limited field of physiology. The newer concepts in synaptic mediation, mechanism of action of tranquilizers, intracranial fluids and barriers, and some aspects of information theory and behavior will be offered. Detailed topic outline to be announced. One two-hour lecture-conference per week. Quarter to be announced (alternate years); $\frac{1}{2}$ unit. Prerequisite: Credit or registration in Physiology 301, 302, and 303. Greenberg, Taylor.
- 484. Space Physiology.** A course for students desiring detailed knowledge of a limited field of physiology. The respiration and acceleration aspects of aviation physiology will be offered. Detailed topic outline to be announced. One two-hour lecture-conference demonstration period per week. W (alter-

nate years); ½ unit. Prerequisite: Credit or registration in Physiology 301, 302, or 303. Marbarger, Marotta.

- 486. Cell Physiology.** The structural and functional organization of the cell. This includes a discussion of the function of the nucleus and the cytoplasmic particulates and their interaction. Two one-hour lectures per week. Quarter to be announced (alternate years); ½ unit. Prerequisite: Biochemistry 301, 302; Physiology 301, 302, 303. Tedeschi.
- 487. Experimental Approaches to Cell Physiology.** The application of modern techniques in the study of the physiology of the cell. This laboratory course complements Physiology 486. Registration limited. Prerequisite: Physiology 486 and/or consent of instructor. One four-hour laboratory-conference per week. Sp (alternate years); ½ unit. Tedeschi.
- 488. Transport Across Cell Interphases.** Discussion of basic mechanisms underlying transport of water, electrolytes, and non-electrolytes across biological membranes. Three one-hour lectures per week. Quarter to be announced (alternate years); ¾ unit. Prerequisite: Physiology 301, 302, 303; Biochemistry 301, 302. Omachi.
- 489. Molecular Basis of Muscle Contraction.** This is an advanced course dealing with the molecular basis of muscle contraction. The problems of the energetics, mechanics, and chemistry of muscle will be considered in detail. There will be some discussion of pathology, pharmacology, and the comparative physiology of muscle relating to the areas designated above. Lectures. ¾ unit. Prerequisite: Physiology 301, 302, 303; Biochemistry 301, 302. Alpert.
- 491. Seminar in Physiology.** F, W, Sp; ¼ unit each quarter. Prerequisite: Credit or registration in Physiology 301, 302, 303, or equivalent. Staff and distinguished guests.
- 493. Research in Physiology.** F, W, Sp, S; ½ to 3 units each quarter. Prerequisite: Credit or registration in Physiology 301, 302, 303, or equivalent. Staff.
- 494. Tactics and Strategy of Research in Physiology.** In this seminar there will be an analysis of the various approaches which have been of recent importance in solving problems in physiology. New techniques, preparations, or new designs which have been instrumental in advancing physiology will be discussed and analyzed in depth. Registration limited. F; ¼ unit. Staff.
- 495. Tactics and Strategy of Research in Physiology.** Continuation of Physiology 494. Registration limited. W; ¼ unit. Staff.
- 496. Tactics and Strategy of Research in Physiology.** Continuation of Physiology 495. Registration limited. Sp; ¼ unit. Staff.
- DP-1. Fundamentals of Shop Practice.** A departmental course designed to acquaint graduate students with woodworking, sheet metal working, and machine tools, and to provide training in their use. Hand and power tools; circular and band saw, drill press, jointer, sanders, grinder, bench lathe, milling machines, sheet metal brake, and shear. Students in the

Department of Physiology who take this course and are certified at the various machines may be allowed access to such facilities of the departmental shops in support of their research and teaching. One four-hour period per week for one quarter. W, Sp; zero credit. Staff.

Public Health, Biometrics, and Statistics

A graduate program leading to a degree is not offered by this department. Students registered for graduate work in basic sciences and other areas may take advantage of the courses offered by this department.

GRADUATE TEACHING FACULTY

Professors: HOWARD J. SHAUGHNESSY (Head of Department), HERBERT C. BATSON.

COURSES FOR GRADUATES

391. **Statistical Methods in Dental Research.** A course designed as an introduction to the statistical design, analysis, and interpretation of experiments in dental research. Sp; $\frac{1}{2}$ unit. Batson.
401. **Biometrics and Applied Statistics.** This course is designed as an introduction to the rational use of simple statistical methods in the planning of experiments and evaluation of results. S; 1 unit. Batson.
403. **Advanced Biometric Methods.** Lectures, assigned readings, and problems dealing with advanced statistical analyses of the relationship between variables including multiple and curvilinear correlations, multiple and curvilinear regressions, and covariance adjustment. F, W, or Sp; $\frac{1}{2}$ unit. Prerequisite: Public Health 401 and consent of instructor. Batson.
410. **Principles of Public Health.** In this course consideration is given to the history and philosophy of the modern public health movement, to the social, cultural, and biological factors in human populations, and the relationships of the individual and the community to the environment. The organizations developed by communities to cope with the changing factors in the physical, biological, and social environment of man are discussed in relationship to the prevention and control of disease and in the promotion of health. F; $\frac{3}{4}$ unit. Shaughnessy.
411. **Health Education.** An introductory course in health education. Consideration is given to the principles of health education and their application to specific individual, group, and community health problems. Basic principles, methods and procedures, and tools and resources of health education are discussed. W; 1 unit.
412. **Occupational Health.** A survey of health problems in modern industrial organizations designed to meet the needs of executives, industrial physicians and nurses, union officers, social workers, and all persons interested in community health problems. Among the subjects discussed are: the relation of working conditions to health, the elimination of hazards in industry,

preventive medical services for workers, and the role of community agencies in protecting the worker's health. W; ½ unit.

- 418. Design of Experiments.** An advanced course dealing with the statistical design and analysis of experiments. W; ½ unit. Prerequisite: Public Health 401 or equivalent and consent of instructor. Batson.
- 419. Design of Experiments.** Continuation of Public Health 418. Sp; ½ unit. Batson.
- 421. Statistics of Bioassay.** An advanced course dealing with statistical design and analysis of bioassays. W; ½ unit. Prerequisite: Public Health 401 or equivalent and consent of instructor. Batson.
- 425. Special Topics in Statistics.** A course dealing with selected topics in statistics and design of experiments. The specific content of the course is to be determined by the needs and interests of students concerned but is to include such topics as: endpoint estimation, sequential designs, design and analysis of clinical trials, data presentation and processing, computer techniques, etc. F, W, Sp, S; ½ unit. Prerequisite: Public Health 401 and/or consent of instructor. Batson.
- 426. Special Topics in Statistics.** Same as Public Health 425 except more extensive in terms of topics concerned. F, W, Sp, S; ½ to 1 unit. Prerequisite: Public Health 401 and/or consent of instructor. Batson.
- 427. Special Topics in Statistics.** Same as Public Health 425 and 426 except still more extensive in scope of topics presented. F, W, Sp, S; ½ to 1 unit. Prerequisite: Public Health 401 and/or consent of instructor. Batson.
- 430. Principles of Epidemiology.** Epidemiology is presented as a science which underlies the study of all mass phenomena of disease. It is demonstrated to be synonymous with human ecology. The principles of the epidemiologic method are presented and the ways in which these can be used to establish and test hypotheses on which preventive and control measures can be based are demonstrated. Sp; 1 unit. Lepper, Shaughnessy, and others.
- 491. Biometric Seminar.** Student presentation of selected or assigned topics in biometrics or applied statistics. F, W, or Sp; ½ unit. Prerequisite: Public Health 401 and consent of instructor. Batson.

Radiology

The graduate curriculum in radiology leads to the Master of Science degree. Graduate work in the field of radiology is provided for the purpose of stimulating the development of critical investigators and intelligent teachers. Facilities are available for research on monochromatic and high intensity soft radiations, on the betatron in its relationship to applied physics and radiobiology, and in the field of experimental and clinical application of radioactive isotopes.

For majors in the department, the Doctor of Medicine or Doctor of Dental Surgery degree is required, except that undergraduate students may

be accepted on a selective basis if they are pursuing work toward the Doctor of Medicine degree and meet the general admission requirements of the Graduate College. The Master of Science degree is not awarded before completion of requirements for the Doctor of Medicine degree.

Courses required of all candidates are Radiology 401, 402, 403, or Pharmaceutical Chemistry 325 and at least four units in Radiology 493, and one seminar in a basic science per quarter for three quarters. Attendance is also required at conferences and seminars.

The thesis must be based on an original investigation.

GRADUATE TEACHING FACULTY

Professor: ROGER A. HARVEY (Head of Department).

Research Professor: WALTER S. MOOS.

Assistant Professor: JACQUES OVADIA.

COURSES FOR GRADUATES

401. **Radiation Physics for Medical Application.** Weekly conferences on theory, mathematics, mechanics, production, detection, and protection from radiation sources; discussions on radiobiology; analysis of pertinent clinical and research problems. Intended for advanced graduate students using radiant energy. F; $\frac{1}{2}$ unit. Moos.
402. **Radiation Physics for Medical Application.** Continuation of Radiology 401. W; $\frac{1}{2}$ unit. Moos.
403. **Radiation Physics for Medical Application.** Continuation of Radiology 402. Sp; $\frac{1}{2}$ unit. Moos.
410. **Radioactive Isotopes.** Fundamentals of radioactivity are discussed in terms of simple theory, biological effects, and experimental and clinical uses. Stress is placed upon proper techniques for handling, using, storing, and disposing of these hazardous materials. F, W, or Sp; $\frac{3}{4}$ unit ($\frac{1}{4}$ unit each quarter). Harvey, Moos.
493. **Research in Radiology.** Research in the physical and biological aspects of radiography and radiotherapy using such instruments as monochromatic beams, isotopes, and the betatron. F, W, Sp, S; $\frac{1}{2}$ to 3 units each quarter. Staff.

Surgery

Graduate training in surgery leads to the Master of Science and Doctor of Philosophy degrees and is designed primarily to aid in the acquisition of a knowledge of basic sciences, particularly that related to surgical problems. The art of surgery which pertains to surgical techniques has no place in the program of candidates for the Master of Science degree. The candidate for the degree of Doctor of Philosophy must devote the major portion of his time to research but must also become exposed to the art of surgical tech-

niques, though the time so devoted shall not apply toward residence requirements or unit values in the Graduate College. Work in the basic sciences is essential for a well-trained scientific surgeon, but this work alone is not sufficient to qualify a candidate for a Doctor of Philosophy degree in surgery. He must also be cognizant of the clinical and scientific phases of preoperative and postoperative care as well as surgical convalescence, and this knowledge can not be achieved by a pursuit of basic sciences alone.

A Doctor of Medicine degree is required for admission with the exception that medical students who have completed one year of the medical curriculum may apply for graduate work toward a Master of Science degree if they fulfill the general requirements for admission to the Graduate College. Such candidates are not granted a graduate degree in surgery until they have completed requirements for the Doctor of Medicine degree.

A minor is not required for the master's degree, but the candidate is required to obtain at least two units in research courses and one unit in formal non-research courses in the 400 series exclusive of seminar courses. Since the Department of Surgery does not offer any formal graduate courses, these requirements must be met by taking the courses offered in the basic science departments which support the student's research interests. Attendance at surgical pathologic conferences, journal club, and surgical research seminars is required.

An applicant for the Doctor of Philosophy degree may choose a minor in one of the basic sciences, and a graduate faculty member in the basic science department is the co-adviser with the candidate's major adviser on his research work and thesis. The qualifying committee outlines a program of non-research courses, exclusive of seminar courses, at least three units of which must be in the 400 series. These courses are chosen from those offered in departments other than the Department of Surgery, which does not offer formal non-research courses. Courses taken during the master's program may be used to satisfy the above requirements.

GRADUATE TEACHING FACULTY

Professors: WARREN H. COLE (Head of Department), EDWARD J. BEATTIE, JR., ORMAND C. JULIAN, MAX S. SADOVE.

Associate Professor: JAMES H. McDONALD.

COURSES FOR GRADUATES

491. Surgical Seminar. Discussion of research problems, review of important literature, presentations of research data, and discussion of recent advances in surgical research. F, W, Sp, S; ½ unit each quarter. Staff.

493. Research in Surgery. Research investigations of problems in surgery, exclusive of technique. F, W, Sp, S; 1 to 3 units each quarter. Staff.

FIELDS OF INSTRUCTION LEADING TO A PROFESSIONAL GRADUATE DEGREE

Nursing — M.S.N. Degree

A five-quarter program of advanced study leading to the Master of Science in Nursing (M.S.N.) degree is offered for the preparation of supervisors and teachers in the following fields: medical surgical nursing; pediatric nursing; psychiatric nursing. Courses in advanced clinical nursing, management of nursing services, related social and natural sciences, curriculum and instruction, and research methodology are required. Other courses may be elected in areas of individual need or interest.

Supporting courses include cognate courses in other departments and relevant electives chosen by the student and approved by the adviser. Students in all clinical fields of nursing are urged to consider Science Orientation (Microbiology 360) in the first quarter of graduate work.

For those in psychiatric nursing, supporting courses will be selected more commonly from the behavioral sciences, though students may choose to elect relevant courses in physiology (Physiology 301, 302, 303, 404, 482). Graduate courses in psychology, sociology, personality structure and development, and anthropology in nearby universities may be considered.

For those in pediatric nursing and medical-surgical nursing, supporting courses will be explored as an integral part of each of those areas of study.

Supporting courses related to curriculum and instruction include philosophy and history of education, advanced psychology and sociology of education, tests and measurements in instruction, theories of educational and social change, and counseling and guidance.

Courses relevant to management of nursing services include personnel management, human relations in industrial or other organizations, industrial organization and management, and hospital organization.

These and many other relevant courses are available in the graduate offerings of other universities in Chicago.

Courses in probability and statistics on this campus or others nearby will be suggested. Biometrics and Applied Statistics (Public Health 401) will be suggested. Some students may choose to elect Design of Experiments (Public Health 418 and 419) as supporting courses.

OBJECTIVES

1. To develop expertness in the practice of one clinical field of nursing.
2. To develop competence in utilizing clinical expertness in either teaching of nursing or supervision of nursing services in a specific area.
3. To learn investigative skills needed to expand the body of knowledge upon which nursing practice is based.

4. To develop further the ability to collaborate with other professionals in the health field.
5. To deepen commitment to the utilization of professional competence to further the objectives and the services of the profession.

ADMISSION

Admission may be granted to those who have completed a Bachelor of Science degree in nursing, substantially equivalent to the baccalaureate degree program of the College of Nursing, University of Illinois. A minimum scholastic average of 3.5 (midway between B and C) in undergraduate work is required. Those whose average is less than 3.75 must take the Graduate Record Examination consisting of the general aptitude test and one advanced test in an area of the student's choice offered by the Educational Testing Service, Princeton, New Jersey. Each applicant must be licensed to practice as a professional nurse in at least one political jurisdiction and must pass an examination required by the Department of Nursing to determine basic skills and knowledge as well as potential for professional practice in an elected field of specialization.

Requests for admission should be directed to the College of Nursing. All application data including application forms, transcripts, letters of recommendation, Graduate Record Examination scores, and requests for financial aid should be forwarded to the College of Nursing for consideration. A personal interview with the Dean of the College of Nursing is desirable and in some instances may be required.

Requirements for graduation include the completion of the five-quarter curriculum with grades and units which meet the general requirements of the Graduate College, satisfactory completion of a thesis on a subject approved by the major adviser, and sustaining an oral examination on the thesis conducted by a committee appointed by the Associate Dean of the Graduate College. Completion of all requirements for the degree of Master of Science in Nursing (M.S.N.) must be realized within five calendar years after first registration in the Graduate College. Except where otherwise indicated, the general policies of the Graduate College will apply to graduate work conducted in advanced nursing disciplines. Students who wish to pursue work toward the Ph.D. degree in a basic science discipline must fulfill the requirements of the Graduate College and the department for admission.

TEACHING FACULTY

Professors: MARY K. MULLANE, MELVIN SABSHIN.

Associate Professors: RACHEL BLISS, EMILY C. CARDEW, MARY M. LOHR.

Assistant Professors: HELEN W. DUNN, LILLIAN OERTEL.

OUTLINE OF CURRICULUM PATTERN

		<i>Units</i>
Quarter 1		
Nursing 350.	Advanced Psychiatric Nursing.....	$\frac{3}{4}$
Nursing 350-L.	Laboratory Practice in Psychiatric Nursing.....	$\frac{1}{2}$
	Supporting Graduate Courses (Electives).....	1 to $1\frac{1}{2}$
Nursing 491.	Seminar in Nursing.....	$\frac{1}{4}$
	Total.....	$2\frac{1}{2}$ to 3
Quarter 2		
Nursing 451.	Advanced Psychiatric Nursing.....	$\frac{3}{4}$
Nursing 451-L.	Laboratory Practice in Psychiatric Nursing.....	$\frac{1}{2}$
	Supporting Graduate Courses (Electives).....	$\frac{1}{4}$ to $\frac{1}{2}$
Nursing 493.	Research in Nursing.....	$\frac{1}{2}$
Public Health 418, 419, or 401.	Biometrics and Applied Statistics.....	$\frac{1}{2}$
Nursing 491.	Seminar in Nursing.....	$\frac{1}{4}$
	Total.....	$2\frac{3}{4}$ to 3
Quarter 3		
Nursing 452.	Advanced Psychiatric Nursing.....	$\frac{3}{4}$
Nursing 452-L.	Laboratory Practice in Psychiatric Nursing.....	$\frac{1}{2}$
	Supporting Graduate Courses (Electives).....	0 to $\frac{1}{2}$
Nursing 493.	Research in Nursing.....	$\frac{1}{2}$
Nursing 383.	Principles of Administration or	
Nursing 370.	Curriculum and Instruction.....	$\frac{1}{2}$
Nursing 491.	Seminar in Nursing.....	$\frac{1}{4}$
	Total	$2\frac{1}{2}$ to 3
Quarter 4		
Nursing 453.	Advanced Psychiatric Nursing.....	$\frac{3}{4}$
Nursing 453-L.	Laboratory Practice in Psychiatric Nursing.....	$\frac{1}{2}$
	Supporting Graduate Courses (Electives).....	0 to $\frac{1}{2}$
Nursing 478.	Evaluation in Nursing.....	$\frac{1}{2}$
Nursing 493.	Research in Nursing.....	$\frac{1}{2}$
Nursing 491.	Seminar in Nursing.....	$\frac{1}{4}$
	Total.....	$2\frac{1}{2}$ to 3
Quarter 5		
Nursing 474.	Practice Teaching in Nursing or	
Nursing 487.	Practice Supervision in Clinical Nursing.....	1
	Supporting Graduate Courses (Electives).....	$\frac{1}{2}$ to $1\frac{1}{4}$
Nursing 493.	Research in Nursing.....	$\frac{1}{2}$
Nursing 491.	Seminar in Nursing.....	$\frac{1}{4}$
	Total	$2\frac{1}{4}$ to 3

Total Units 12½ to 15

- 1. Formal Courses — 300 series 1¾ units
- 2. Formal Courses — 400 series 5¾ units
- 3. Research 493 2 units
- 4. Seminar 491 1¼ units
- 5. Electives (300 and 400 series) 1¾ to 4¼ units

COURSES FOR GRADUATES

- 370. Curriculum and Instruction.** A study of instruction, learner interaction with his environment, including the teacher; sources and identification of educational objectives; selection of learning experiences and instructional methods appropriate to the desired outcomes; organization of learning experience; appraising educational results. Faculty members' role in curriculum evaluation and revision. Emphasis on general principles with specific application to education for professional nursing. Three hours of lecture discussion per week. Sp; ½ unit. Cardew.
- 383. Principles of Administration.** Principles, objectives, and methods of administration applied to management of a clinical nursing division in a modern hospital. "Classic" approaches to management; review of hospital structure and function; organization and direction of a clinical nursing division; administration as leadership. Three hours of lecture and discussion per week. Sp; ½ unit. Mullane, Dunn.
- 474. Practice Teaching in Nursing.** Guided experience in teaching nursing in both classroom and clinical settings. Students will have opportunity to develop, teach, and evaluate the outcomes of a unit in the content of their clinical specialty, including evaluating and counseling students in clinical practice. Twelve hours per week in observation, conference, and practice. W; 1 unit. Prerequisite: Nursing 370 and 478, or equivalent. Cardew and staff.
- 478. Evaluation in Nursing.** A study of the purposes, principles, and methods appropriate to determining degree of progress toward desired goals in education and nursing practice. Theory of measurement and principles of item writing and test construction. Methods of appraising nursing care and the evaluation of practitioners of nursing and of student progress in clinical experience. Emphasis on the use of the evaluation program to improve nursing care, facilitate learning, and evaluate the total program (curriculum or institutional). F; ½ unit. Cardew.
- 487. Practice Supervision in Clinical Nursing Services.** Guided experience in planning, organizing, and managing a clinical division of a hospital nursing service. Includes opportunity to observe and to participate in the supervisory role; planning a supervisory program; designing strategy for effecting change and for evaluating supervisory outcomes. Twelve hours per week in observation, conference, and practice. W; 1 unit. Prerequisite: Nursing 383, 478, or equivalent. Mullane, Dunn, and staff.
- 491. Seminar in Nursing.** Identification and analysis of problems of education for

nursing, preservice and inservice; of organizing and administering programs of patient care in hospitals and out-patient services; review of relationships between nursing education and nursing service and critique of some new proposals. Two hours discussion each week. Required during the fourth and fifth quarters of graduate study. F, W, Sp, S; ¼ unit each quarter. Staff.

493. **Research in Nursing.** Study of major methods of research appropriate to investigation of nursing problems and guidance in individual research leading to a satisfactory thesis. F, W, Sp, S; ½ to 3 units each quarter. Mullane and staff.

Psychiatric Nursing Sequence

The objectives and advanced nursing course descriptions which follow refer specifically to psychiatric nursing. Relevant supporting and elective courses are also included here for completeness.

OBJECTIVES

1. To learn to administer skillfully various therapies prescribed by the physician and to provide high level clinical care.
2. To develop increased self-understanding basic to the refinement of interpersonal competencies needed by the psychiatric nurse.
3. To develop high level competence in the appropriate use of one-to-one relationships with psychiatric patients in all diagnostic categories and all degrees of illness.
4. To learn to work appropriately with persons in all the mental health disciplines.
5. To learn to function effectively within the framework of various treatment regimes.
6. To develop skill in analyzing the social setting in which patients live (hospitals, half-way houses, families), determining influences upon patient care, and taking appropriate action toward making the setting more therapeutic.
7. To develop high level competence in group work with psychiatric patients.
8. To develop leadership skills needed by the psychiatric nurse.
9. To develop facility in the use of methods which show promise in prevention and reduction of the disability of emotional disorders.
10. To develop investigative skills needed to expand the theory and improve the practice of psychiatric nursing.

COURSES FOR GRADUATES

350. **Advanced Psychiatric Nursing.** Concentrated study of the nursing care of psychiatric patients in the major diagnostic categories. Discussion of psy-

chosocial development, major psychopathological syndromes, phases of nurse-patient relationships, and approaches to the study of group behavior. Lectures, discussions, and demonstrations. Must be taken simultaneously with Nursing 350-L. F; $\frac{3}{4}$ unit. Lohr, Sabshin.

- 350-L. Laboratory Practice in Psychiatric Nursing.** Observation and supervised practice within psychiatric settings, correlated with instruction in Nursing 350; must be taken simultaneously. F; $\frac{1}{2}$ unit. Lohr, Bliss, Oertel.
- 451. Advanced Psychiatric Nursing.** Continued exploration in depth of nurse-patient relationships with individual and groups of psychiatric patients. Discussion of major approaches to the study and treatment of psychiatric illness, multiple role functions of the psychiatric nurse, and current conceptions of psychiatric nursing. Lectures, discussions, and demonstrations. Must be taken simultaneously with Nursing 451-L. W; $\frac{3}{4}$ unit. Lohr, Sabshin.
- 451-L. Laboratory Practice in Psychiatric Nursing.** Observation and supervised practice within psychiatric settings, correlated with instruction in Nursing 451; must be taken simultaneously. W; $\frac{1}{2}$ unit. Lohr, Bliss, Oertel.
- 452. Advanced Psychiatric Nursing.** Continued study of the nursing care of psychiatric patients. Discussion of general theory of communication in psychiatry and role of the nurse in facilitating communication. Study of patterns of patient care and functions of the psychiatric nurse within diverse treatment settings and in special situations requiring specific nursing action. Lectures, discussions, and demonstrations. Must be taken simultaneously with Nursing 452-L. Sp; $\frac{3}{4}$ unit. Lohr, Sabshin.
- 452-L. Laboratory Practice in Psychiatric Nursing.** Observation and supervised practice within psychiatric settings, correlated with instruction in Nursing 452; must be taken simultaneously. Sp; $\frac{1}{2}$ unit. Lohr, Bliss, Oertel.
- 453. Advanced Psychiatric Nursing.** Study of emotional problems of childhood and adolescence, psychosomatic disorders, and the family as a resource for care and prevention of emotional disorders. Special emphasis on the role of the nurse in strengthening healthy forces within a family setting. Discussion of legal aspects of psychiatric nursing and implication within report of Joint Commission on Mental Illness and Health for practice of psychiatric nursing. Lectures, discussions, and demonstrations. Must be taken simultaneously with Nursing 453-L. F; $\frac{3}{4}$ unit. Lohr, Sabshin.
- 453-L. Laboratory Practice in Psychiatric Nursing.** Observation and supervised practice within psychiatric and/or community agencies, correlated with Nursing 453; must be taken simultaneously. F; $\frac{1}{2}$ unit. Lohr, Bliss, Oertel.

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